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PROBLEMS OF NEBULAR RESEARCH

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The Observable Region of Space

The history of astronomy is a history of receding horizons. The explorations of space have swept outward in successive waves—through the system of the planets, through the stellar system and, recently, into the realm of the nebulae. A large sample of the universe is now available for study, and the sample may be fair.

The general picture of the Observable Region is somewhat as follows:

The earth we inhabit is a member of the solar system. The sun with its family of planets seems isolated in space but the sun is merely a star—one of the millions which populate our particular region of the universe. The stars are scattered about at enormous intervals but on a still greater scale they are found to form a definite system, again isolated in space. On the grand scale we may picture the stellar system drifting through the universe as a swarm of bees drifts through the air.

From our position somewhere within the system, we look out through the swarm of stars, past the borders, into the universe beyond. It is empty for the most part—vast stretches of empty space. But here and there, at immense intervals, we find other stellar systems, comparable with our own. They are so distant that in general we do not see the individual stars. They appear as faint patches of light, and hence are called nebulae, *i.e.*, clouds.

The nebulae are great beacons, scattered through the depths of space. We see a few that appear large and bright. These are the nearer nebulae. Then we find them smaller and fainter in constantly increasing numbers, and we know we are reaching out into space farther and ever farther until, with the faintest nebulae that can be detected with the greatest telescopes, we have reached the frontiers of the known universe. This last horizon defines the Observable Region—the region of space which can be explored with existing telescopes. It is a vast sphere, some 1,000 million light years in diameter, throughout which are scattered 100 million nebulae.

The question immediately arises as to whether the nebulae form an isolated super-system, analogous to the system of the stars but on a still grander scale. Actually, we find the nebulae scattered singly, in groups and occasionally in great clusters but, when very large volumes of space are considered, the tendency to cluster averages out, and, to the very limits of our telescopes, the distribution is approximately uniform. If the Observable Region is divided into 100, 1,000 or even 10,000 equal parts, the

nebular contents of the various fractions are very closely similar. There is no evidence of a thinning out, no trace of a physical boundary. The realm of the nebulae, we must conclude, stretches on and on, far beyond the known frontiers.

Observations give not the slightest hint of a super-system of nebulae. Hence, for purposes of speculation, we may invoke the principle of the Uniformity of Nature and suppose that any other equal portion of the universe, chosen at random, will exhibit much the same general characteristics as the region we can explore with our telescopes. As a working hypothesis, serviceable until it leads to contradictions, we may venture the assumption that the realm of the nebulae *is* the universe—that the Observable Region is a fair sample, and that the nature of the universe may be inferred from the observed characteristics of the sample.

The Nature of the Problems

Investigations in these new fields follow two lines of attack. The individual nebulae may be studied as stellar systems, or the Observable Region may be studied as a unit. The ultimate problems, as usual, are formulated in evolutional terms. On the one hand, we wish to describe the individual nebulae as particular stages in the life history of stellar systems. On the other hand, we wish to describe the Observable Region as a local aspect of a particular stage in the life history of the physical universe. The solutions of these problems are beyond our present powers but the formulations serve as an ordered framework into which all the limited, detailed investigations find their places.

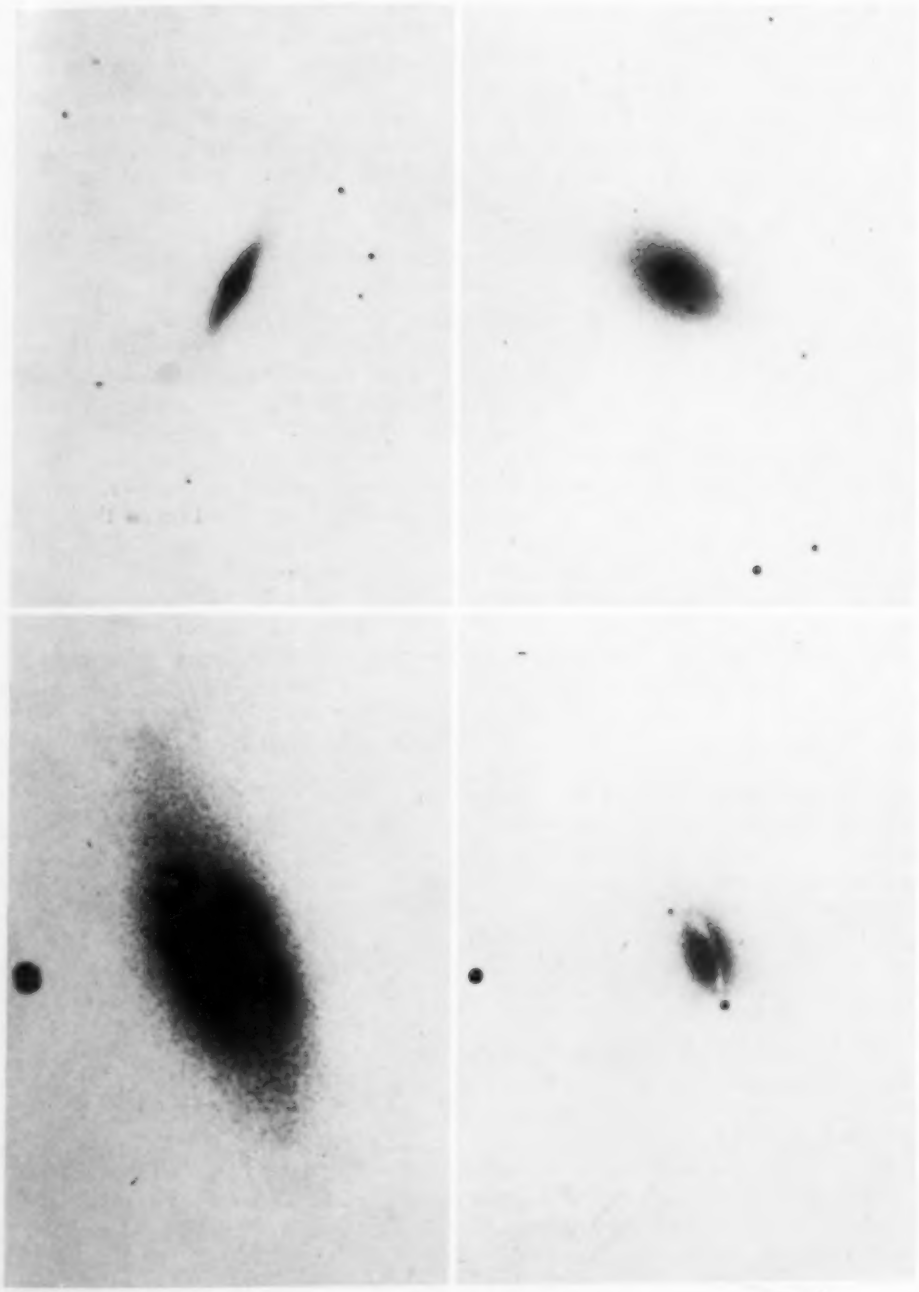
Progress may be summarized as follows. An approximate scale of distance has been established throughout the Observable Region. Dynamical information is slowly accumulating but is still fragmentary. The time scale is wholly speculative.

The Distance Scale

The distance scale permits a static description of the Observable Region and its contents, and the preliminary sketch has been completed. We know, in a general way, the structural forms of nebulae, the brighter elements of their contents, their dimensions and their distribution throughout the Observable Region. This preliminary phase of the subject is probably approaching its final form. Further investigations may be expected to fill in details and improve the numerical accuracy without seriously changing the general outlines.

The distance scale followed the identification, in the nearer nebulae, of objects that are well known in our own stellar system. Novae, for instance, clusters, diffuse nebulosities, blue supergiants and, in particular, Cepheid variables were recognized, all in their proper order of relative luminosities. Since their intrinsic luminosities are known, their apparent faintness indicates their distances wherever they are found. For instance, some 40 Cepheids in the great spiral in Andromeda are known to average about 3,000 times brighter than the sun but they appear about 150,000 times fainter than the faintest star that can be seen with the naked eye. A simple calculation indicates that the spiral must lie at a distance of nearly a million light years, and other types of objects found in the spiral confirm the order of this result.

A few reliable distances, determined in this manner, have served to calibrate other methods, less accurate but extending over greater ranges. Eventually, it was found that the nebulae are all of the same general order of total luminosity. They average about 80 million suns, and the majority lie between the narrow limits from one half to twice the



TRANSITION TYPES

Upper left: LENTICULAR SYSTEM, NGC 4350, CLASSED AS E7, THE FLATTEST OF THE ELLIPTICAL NEBULAE. *Upper right:* NGC 4150, THE EARLIEST OF THE TRANSITION TYPE, SO. A CENTRAL LENS IS VAGUELY DIFFERENTIATED FROM THE MAIN BODY OF THE NEBULA. *Lower:* A LONG AND A SHORT EXPOSURE OF NGC 4526, A MORE ADVANCED FORM OF THE TRANSITION TYPE. THE CENTRAL LENS IS WELL DIFFERENTIATED, AND, WITHIN THE LENS, IS A RING OF FINELY DIVIDED, DARK MATERIAL, PRESUMABLY DUST. (NEGATIVE PRINT.)

average value. Thus the apparent faintness of the nebulae themselves forms a sound statistical criterion of distance out to the very limits of the telescopes. For instance, the faintest nebulae identified with the 100-inch reflector lie at an average distance of the order of 500 million light years. Some of these ghostly images at the threshold of identification on the best plates, are doubtless dwarf systems, much nearer than the average, and some are giants at still greater distances. We can not select these individual objects—we can only state the statistical average. However, it seems likely that no nebula has yet been recognized as such, which lies at a distance greater than 1,000 million light years.

Another criterion of distance is found in the red shifts in the spectra of nebulae. The lines in these spectra are, in general, slightly displaced to the red or to the violet, according to the random velocities of the nebulae as they drift through space. But superposed on this familiar pattern is a systematic displacement to the red which is proportional to the distance. The interpretation of the phenomenon is quite speculative but, regardless of their origin, the red shifts indicate the distances of the individual nebulae, subject only to the errors introduced by the relatively small peculiar motions.

The Sequence of Classification

The characteristic feature of the nebulae is rotational symmetry around dominating central nuclei. About 2.5 per cent. do not show this feature, and are called Irregular. The regular nebulae fall naturally into a continuous sequence of structural forms ranging from compact globular bodies to the widely open spirals. This sequence of classification seems to be fundamental because many features, in addition to structural forms, vary symmetrically throughout the range—stellar contents, for instance, spectral types and colors. The sequence may represent the evolution of stellar systems although this suggestion is highly speculative. We actually observe that the contents of nebulae are correlated with structural forms. We conclude that contents may determine form or that both may be determined by a third factor. In a search for a third factor, we are able to eliminate the quantity of luminous material, and, presumably, the mass. About the only plausible factor left is time, or evolution. Let us examine the sequence with this possibility in mind.

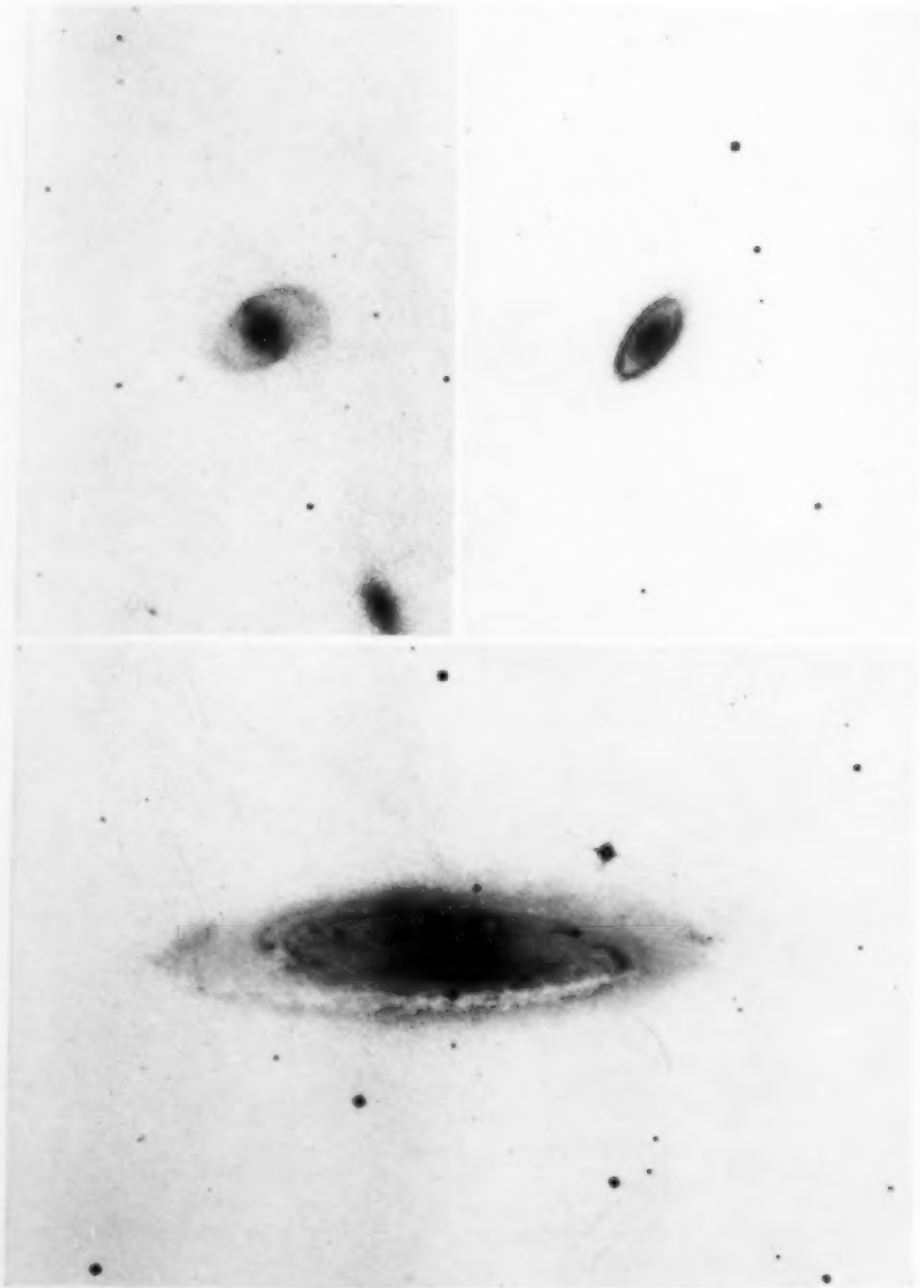
The nebulae fall into two groups, elliptical nebulae and spirals, with a transition stage between them. The members of each group fall into progressive sequence which fit into one another to form the sequence of classification. However, the spirals fall into two parallel series representing the normal and the barred spirals respectively. Thus the complete sequence is bifurcated like a tuning fork.

Elliptical Nebulae

The handle is formed by the elliptical nebulae ranging from globular masses, to flattened, lenticular bodies with a ratio of axes about 3 to 1. These nebulae are very homogeneous. They are not resolved and show no structure other than a steady fading of the luminosity from the center outward to undefined boundaries.

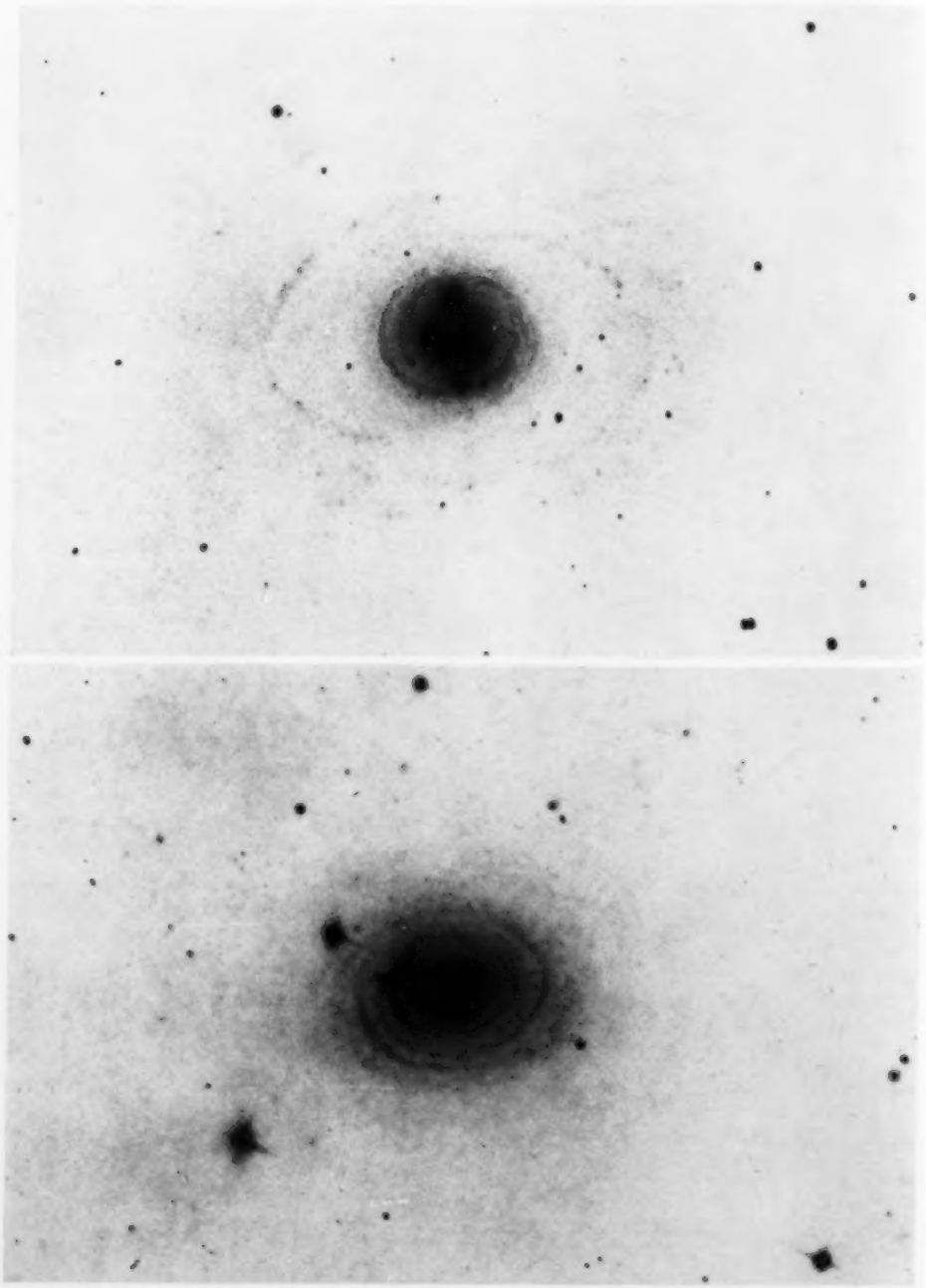
Transition Stage

The transitional stage follows the flat end of the elliptical series. The first evidence of internal structure is the differentiation of a bright central lens with a diameter about one third that of the main body of the nebula. Thereafter, circular patterns of obscuration—lanes of dark, finely divided material, silhouetted against the luminous back-



EARLY TYPE SPIRALS

Upper left: NGC 4440, A BARRED SPIRAL, SBA. *Upper right:* NGC 4324, A NORMAL SPIRAL, SA, IN WHICH A RING STRUCTURE HAS DEVELOPED OUTSIDE THE LENS, AND HAS PARTIALLY DISINTEGRATED. *Lower:* NGC 3623, SA, IN WHICH A SPIRAL PATTERN HAS DEVELOPED WITHIN THE MAIN BODY. (NEGATIVE PRINT.)



INTERMEDIATE TYPE SPIRALS

Left: NGC 488, A NORMAL SPIRAL. *Right:* NGC 1398, A BARRED SPIRAL. THE SPIRAL PATTERNS ARE WELL DEVELOPED, BUT THE NUCLEAR REGIONS REMAIN UNRESOLVED. (NEGATIVE PRINTS)

ground—appear either within the lens or in the faint, outer regions.

Normal Spirals

Along the sequence of normal spirals, the circular patterns eventually disintegrate into spiral structure—first fragmentary, closely coiled arcs, and then longer, more open arms. Fairly early in the series, arms of luminous materials appear, in addition to the absorption lanes, and, as the sequence progresses, these arms dominate the structural patterns. In the last stages, practically the whole of the luminous material, right into the nucleus, is concentrated into widely open arms. The nucleus, in general, remains as a semistellar condensation, somewhat resembling the largest of the globular clusters in brightness and in spectral type.

About the middle of the sequence, the arms begin to break up into condensations representing individual stars and groups of stars. The process generally begins in the outer regions and works inward, until, in the end, it reaches the nuclear region itself. The stars that can be detected are blue supergiants, and their presence is one of the main distinctions between the contents of spirals and the contents of elliptical nebulae. The latter systems lack supergiants. In fact, the data suggest that the upper limit of stellar luminosity increases steadily from globular nebulae to open spirals, and emerges above the observable threshold somewhere in the middle of the sequence of spirals.

Barred Spirals

The sequence of barred spirals branches off from the normal sequence in the early section of the transition stage. A bright diameter appears across the lens and develops into a definite bar which stops abruptly at the rim of the lens. Furthermore, the entire rim of the lens condenses into a ring so that the structural pattern resembles the Greek letter capital Theta. Then, in general, the ring appears to break from the bar at two points—just above the bar at one end, and just below, at the other end. The further behavior is not entirely clear but frequently the broken ends of the ring seem to drift outward and to develop into spiral pattern. The prevailing pattern is that of two arms springing abruptly from either end of a diametrical bar, and winding outward along spiral paths. In the last stages, the arms are almost completely unwound, and approximate straight lines. In other respects, the progress along the sequence closely parallels that along the normal sequence.

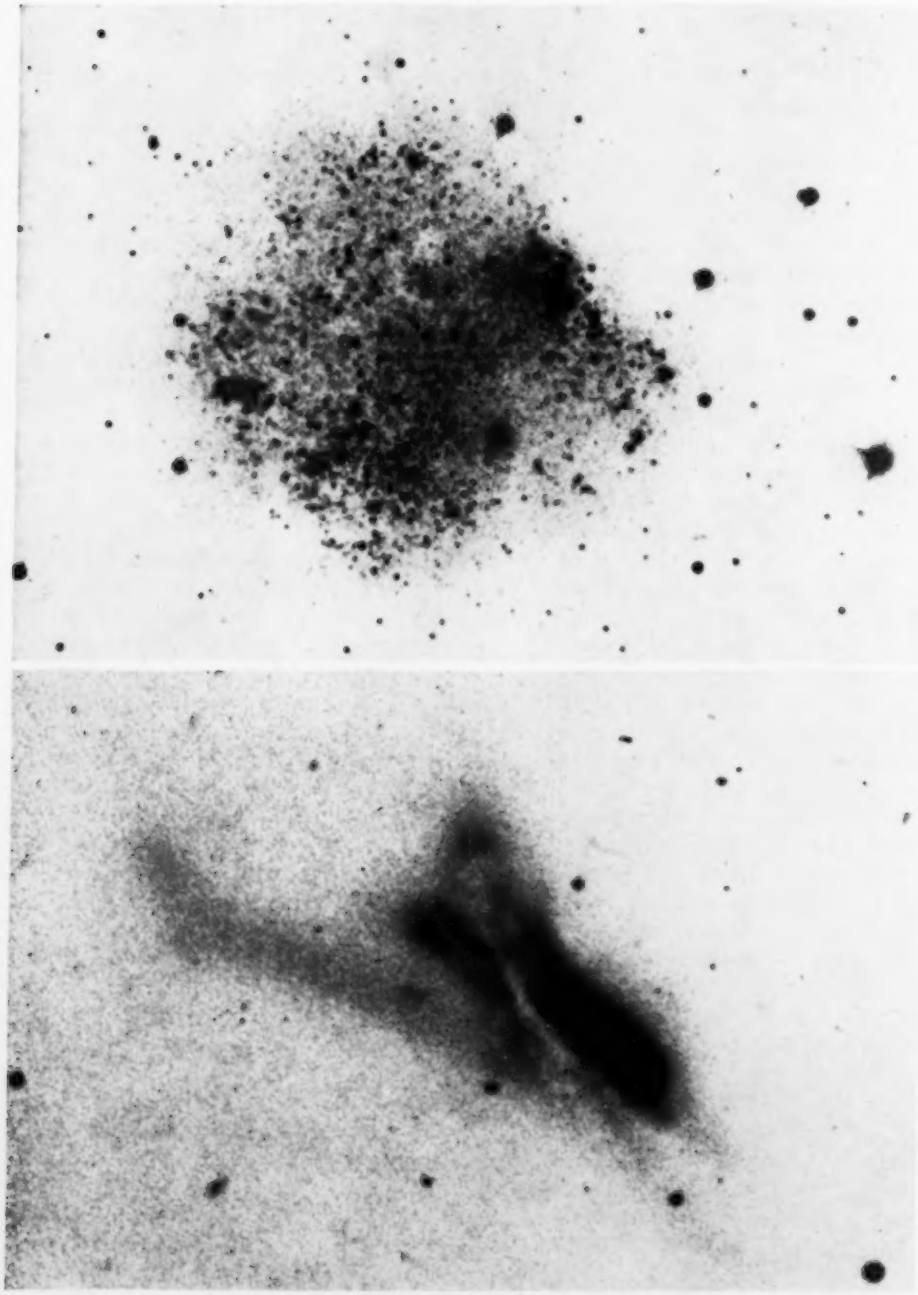
Irregular Nebulae

As an appendix to the sequence, some mention should be made of the irregular nebulae. These fall into two roughly equal groups. One group, represented by NGC 520 and 5128, consists of chaotic masses of unresolved nebulosity and dark material. Little is known concerning these remarkable objects other than the facts that their luminosities and their spectral types are closely comparable with those of regular nebulae. Presumably, they consist of stars and dust and, occasionally, gas but, like the early type nebulae, they lack supergiant stars.

The second group of irregular nebulae contains systems resembling the Magellanic Clouds. They are highly resolved but present no nuclei nor any evidence of rotational symmetry. The luminosities range from those of normal nebulae down to dwarf systems scarcely brighter than the globular clusters. These dwarf irregulars raise an interesting problem, and one of considerable importance in cosmological theory. We wish to know whether there is a lower limit to the size of independent stellar systems or whether they finally merge into smaller

INTERMEDIATE TYPE SPIRALS

Left: NGC 488, A NORMAL SPIRAL. *Right:* NGC 1398, A BARRED SPIRAL. THE SPIRAL PATTERNS ARE WELL DEVELOPED, BUT THE NUCLEAR REGIONS REMAIN UNRESOLVED. (NEGATIVE PRINTS.)



IRREGULAR NEBULAE

Left: NGC 520, A CHAOTIC TYPE. *Right:* BAADE'S SYSTEM IN SEXTANS (R.A. 10h 8.1m; DEC. −4°24′, 1940), A MAGELLANIC CLOUD TYPE. BAADE REPORTS THAT THE SEXTANS SYSTEM IS A FAINT DWARF ($M_{pg} = -10$), AT A DISTANCE OF THE ORDER OF 1.1 MILLION LIGHT YEARS. (NEGATIVE PRINT.)

organizations such as mere clusters of stars?

The specific problem, stated in technical terms, is the determination of the faint end of the luminosity function (*i.e.*, the curve representing the relative frequencies of nebulae of different intrinsic luminosities). The curve is assumed to resemble a normal error curve because the bright end, extending over the peak, is known to approximate that form. However, the faint end is extremely difficult to determine with precision, and we merely guess that the two ends are symmetrical—that giants and dwarfs are equally numerous. The uncertainty is not important for statistical investigations—it is sufficient to know that the curve has a peak, that a most frequent luminosity does exist.

The difficulty arises from the fact that dwarfs, because they are intrinsically faint, can be detected only in our immediate neighborhood—that is, through a small volume of space. The giants, on the other hand, can be observed out to great distances, and hence through a very large volume of space. For instance, giants which are 100 times brighter than dwarfs should be 1000 times more numerous among the nebulae which are brighter than a given limit of apparent faintness. Since our detailed information is restricted to fairly bright limits, the giants are far better known than the dwarfs.

Our nearest neighbors in space are some 12 nebulae which, together with our own system, from a loose cluster, more or less isolated in the general field. Within this cluster, known as the Local Group, there are 5 dwarfs, of which 4 are irregular nebulae of the Magellanic Cloud type. This large percentage of dwarfs is disturbing, and the question arises as to whether or not there are corresponding numbers in the general field which we have missed because they are so faint.

My colleague, Dr. Baade, is investigating this question by studying with the 100-inch reflector a list of possible dwarfs assembled by Dr. Zwicky from surveys with the 18-inch Schmidt reflector on Palomar. Samples of the results are furnished by two uncatalogued systems, in Sextans and in Leo, which are intrinsically the faintest systems known. One, the system in Leo, is no brighter than Omega Centauri, the brightest of the globular clusters.

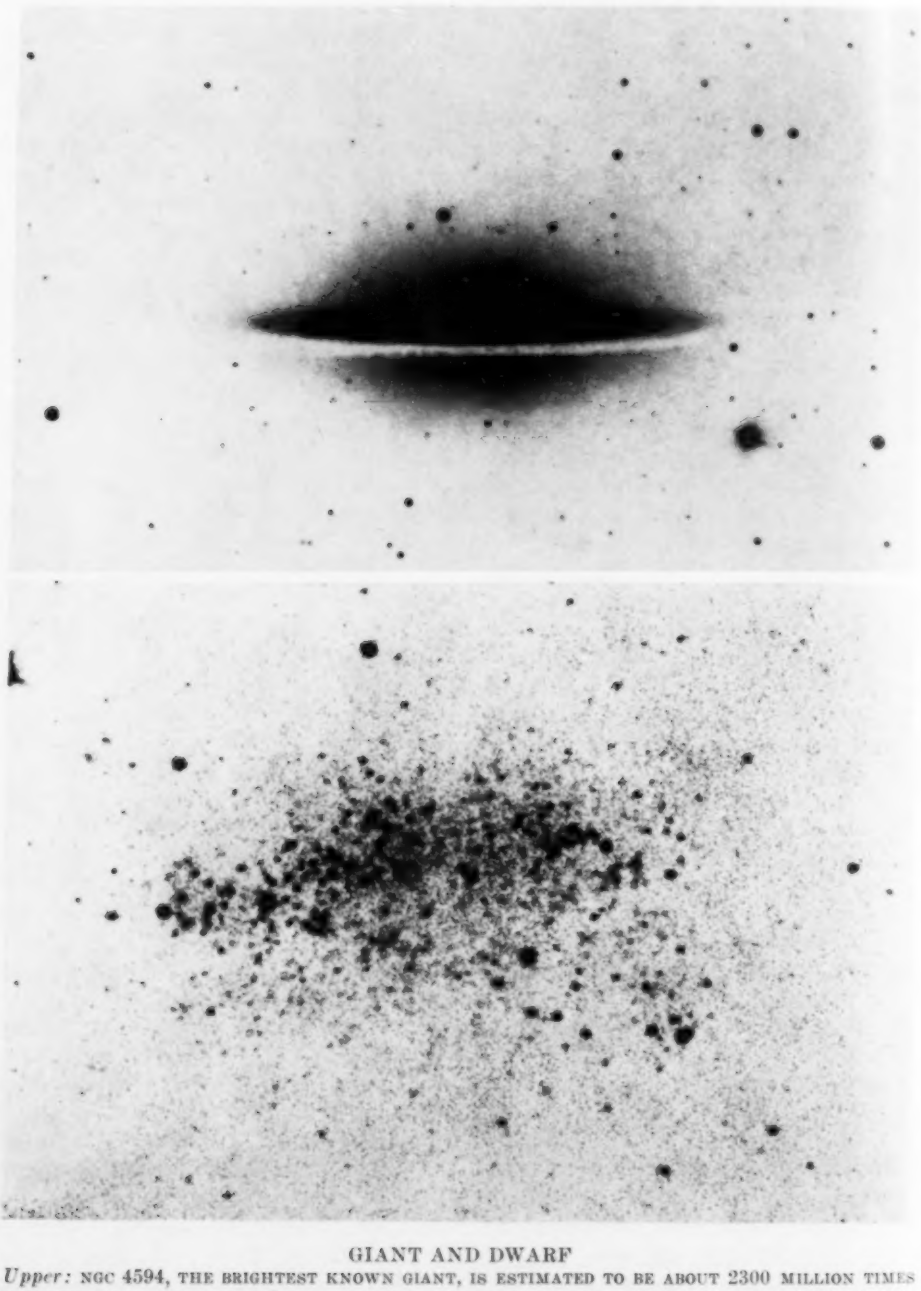
Some General Features of the Sequence

The 1,000 brightest nebulae in the northern sky have all been photographed with large reflectors, and, from these data, the quantitative aspects of the sequence of classification are fairly well known. About $\frac{1}{5}$ are elliptical nebulae and $\frac{1}{5}$ are transitional objects or spirals. Of the spirals, about $\frac{1}{3}$ fall into the barred sequence and $\frac{2}{3}$ into the normal sequence. Only 23 are classed as irregular. The most frequent type is the late type, normal spiral.

At any stage in the sequence, the nebulae are closely similar. They may be large and bright or small and faint but they are built on the same pattern. Thus it is possible to establish and compare standard models at various stages. It is then found that, for nebulae of a given total luminosity, the diameters increase steadily from the globular bodies to the open spirals—the sequence is an expanding sequence, with average diameters ranging from perhaps 1,200 light years to 12,000. This systematic variation, superposed on the inherent scatter in size, must be fully taken into account in any attempt to use the apparent diameters as criteria of distances.

When the sequence is considered from the evolutional point of view, the central problems are (a) the origin and development of spiral arms, and (b) the interpretation of the bars in barred spirals.

Left: NGC 520, A CHAOTIC TYPE. *Right:* BAADE'S SYSTEM IN SEXTANS (R.A. 10h 58.1m; DEC. −4°24′, 1940), A MAGELLANIC CLOUD TYPE. BAADE REPORTS THAT THE SEXTANS SYSTEM IS A FAINT DWARF ($M_{pg} = -10$), AT A DISTANCE OF THE ORDER OF 1.1 MILLION LIGHT YEARS. (NEGATIVE PRINTS.)



GIANT AND DWARF

Upper: NGC 4594, THE BRIGHTEST KNOWN GIANT, IS ESTIMATED TO BE ABOUT 2300 MILLION TIMES BRIGHTER THAN THE SUN. *Lower:* BAADE'S SYSTEM IN LEO (R.A. $9^h\ 55.9^m$; DEC. $+31°2'$, 1940), THE FAINTEST KNOWN DWARF. BAADE ESTIMATES THIS IRREGULAR NEBULA TO BE ABOUT HALF A MILLION TIMES BRIGHTER THAN THE SUN ($M_{pg} = -8.7$). (NEGATIVE PRINT.)

These problems will be mentioned presently, in connection with dynamical investigations. At the moment, attention may be called to one aspect of the subject. It was once believed that spiral arms were normally ejected from two opposite points on the rims of the central lenses. However, accumulating data raise serious doubts as to the validity of this assumption. Theories of the origin and development must now take into account the new empirical results. The earliest evidence of spiral structure is furnished by absorption lanes, evidently representing finely divided, dark material. Moreover, the spiral patterns seem to follow a transitional stage of circular patterns, and both seem to form by the differentiation of material already in place rather than by the ejection of new material into regions previously unoccupied. The significance of the data is not clear but they suggest that viscosity may play an important role in the interpretation of structure.

Supernovae

The discussion of the contents of nebulae will be restricted to one type of object. The most spectacular phenomena observed within the nebulae are the tremendous outbursts known as supernovae. It had long been known that, in addition to the normal novae, so frequently recorded in the galactic system and its nearer neighbors, novae like stars of a totally different order of luminosity were occasionally observed in the nebulae. About 1935, Zwicky initiated an intensive study of these "supernovae," using the 18-inch Schmidt reflector on Palomar, and, later, Baade and Minkowski took up various phases of the problem with the large reflectors on Mt. Wilson. These investigations have led to results of extraordinary significance.

The supernovae represent a definite class of objects quite distinct from normal novae, and averaging nearly 1000 times brighter. No clear evidence of intermediate objects has yet been found. The supernovae at maxima are comparable with the integrated light of the stellar system in which they appear ($M_{pg} = -14.2$, or 80 million suns). Although they are extremely rare—they occur at the rate of one per nebula per several (3 to 6) centuries—the number of nebulae in which they can be observed is so great that several supernovae are generally visible within the Observable Region at any given time. Only those outbursts which occur within our immediate neighborhood, say within 6 or 8 million light years, can be studied to advantage with spectrographs.

The first half dozen supernovae whose spectra were studied in detail proved to be closely similar. The spectra consisted of broad, overlapping emission bands in the red and blue, with very faint, structureless, continuous spectra in the ultraviolet. The bands were well developed even before maximum luminosity, and, in each case, the positions and relative intensities changed as time went on, according to a definite pattern. No single detail has been identified in these spectra, hence, while the general appearance and behavior is well established, the interpretation is wholly unknown.

Just about the time the problem was supposed to be fully formulated, supernovae of another type (now called type II) were recognized by Minkowski, which differ from those described above (now called Type I) in their spectra, and, according to Baade, their light curves and maximum luminosities. Type II supernovae appear to be slightly fainter than Type I, and they present shoulders in the light curves which are absent in the brighter class. The spectra in Type II are continuous through maximum luminosity but, between one and three weeks after maximum, they

SUPERNOVA IN NGC 4725

THE NEBULA IS IN THE LARGE URSA MAJOR GROUP AT A DISTANCE OF THE ORDER OF 5.5 MILLION LIGHT YEARS. THE SUPERNOVA—THE BRIGHT STAR MARKED BY AN ARROW—IS ABOUT 40 MILLION TIMES BRIGHTER THAN THE SUN. THE PLATE WAS MADE BY BAADE WITH THE 100-INCH, ON MAY 10, 1940, FIVE DAYS AFTER THE SUPERNOVA HAD BEEN DISCOVERED BY JOHNSON AT PALOMAR.

develop broad emission bands which, in general, resemble those of normal novae in the transition stage. Hydrogen bands appear to be definitely present, although relatively faint, while the forbidden lines are very faint or missing.

Type II supernovae, it is believed, may contribute essential clues to the interpretation of Type I. The two groups, together, should furnish significant information concerning the behavior of matter under extreme conditions. For supernovae represent explosions on the most tremendous scale known in the universe. Although we observe the explosions millions of years after they actually occur, the reports of the events are carried so faithfully by the light waves that we have no doubts they will eventually be read with confidence.

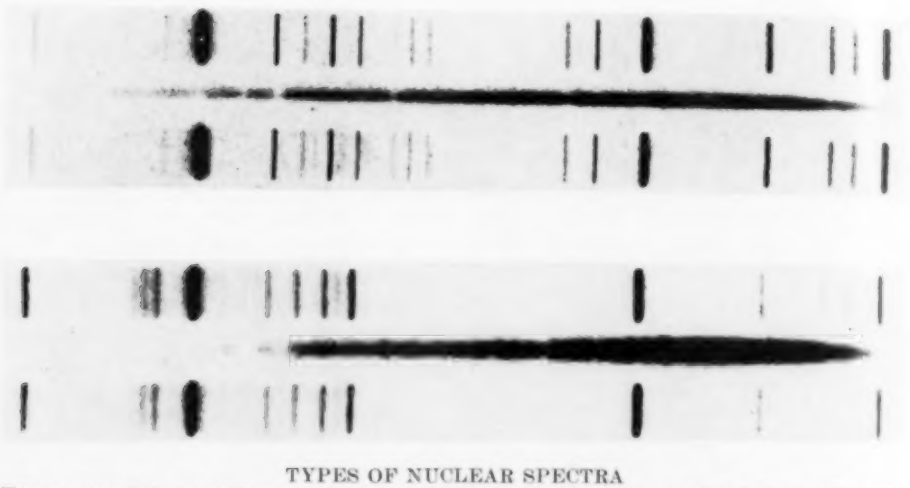
Supernovae have doubtless occurred from time to time within the galactic system but certainly none has been observed since the spectrograph has been in general use. Two historical cases, however, are presumed to represent supernovae. One is Tycho Brahe's star of 1572 which could be seen in broad daylight. The position is known with unusual accuracy, but exhaustive searches have failed to find the remnants of the explosion. The second case is a nova of 1054 which blazed out as bright as Jupiter, and which is recorded in the annals of both the Chinese and the Japanese. The position is only roughly recorded but it is in the vicinity of the Crab Nebula (NGC 1952). The latter object is a mass of nebulosity which is known to be expanding at such a rate that if the rate has remained constant the expansion must have started just about the time the nova was observed. For this reason, the Crab Nebula is assumed to be the remnants of the outburst, which from the apparent brightness and the known distance (order of 5000 light years), was evidently a supernova.

Dynamics of Nebulae

The question of spiral structure introduces the subject of dynamics. The development of this subject requires a knowledge of motions, and, because of the great distances, such data are restricted to radial velocities. Moreover, the nebulae are faint objects and, consequently, the great majority of the available spectra are on very small scales—perhaps 300 to 500 angstroms per mm at $H\gamma$. Nearly 400 such spectra have been assembled at Flagstaff, Mt. Hamilton and Mt. Wilson—about 300 at Mt. Wilson alone. These data furnish a preliminary survey of the field and make it possible to formulate the significant problems that can be investigated. However, the scales are so small that only the most conspicuous phenomena have been isolated and studied to advantage.

For individual nebulae, it has been found that spectral types of the nuclear regions vary systematically through the sequence of classification, ranging from about G5 for the globular nebulae to about F0 for the late type spirals, and that emission lines, indicating the presence of gas, and of stars sufficiently hot to excite the gas (*i.e.*, blue-giants and supergiants) become increasingly prominent as the sequence progresses.

Dynamical data are fragmentary. Motions within nebulae may be either random or systematic. Random motions, in limited regions, should widen the spectral lines, and the velocity dispersions, indicated by the line contours, should furnish important information concerning the distribution of mass within the nebulae. The lines are so narrow that the contours can not be studied on the small scale spectra now available. However, spectrographs and plates have been developing so rapidly that it is now possible to use moderate scales—say 70 Å per mm at $H\gamma$—and to extend the investigations into the red with gratings. These technical achieve-



TYPES OF NUCLEAR SPECTRA

Upper: NGC 598, SC, SPECTRAL TYPE F0. *Lower:* NGC 3384, SB0, SPECTRAL TYPE G5. THE SPECTRA WERE RECORDED WITH A DISPERSION OF 175 A/MM AT Hγ. RED IS AT THE RIGHT; COMPARISONS ARE HELIUM, HYDROGEN AND NEON. NEARLY ALL THE NEBULAE HITHERTO OBSERVED FALL WITHIN THE RANGE OF SPECTRAL TYPES HERE ILLUSTRATED.

ments are expected to open a new chapter in nebular research.

Rotations of Nebulae

Systematic internal motions furnish rotational patterns, and, in spite of the difficulties, such data have already been derived for a half-dozen favorable cases. Four early type nebulae have been studied at Mt. Wilson, and two later type spirals, at Mt. Hamilton. The main bodies of these nebulae rotate like solid bodies—the velocities of rotation increase directly with distance from the nucleus—again suggesting the important role played by viscosity. It seems unlikely that such a phenomenon can extend indefinitely outward but evidence that rotational velocities begin to decrease beyond certain distances, has been fragmentary. However, at the meeting of the American Association at Seattle in June, Dr. Mayall presented a very important study of the pattern for the late type spiral Messier 33, which clarifies the situation to a marked degree. The velocity of rotation increases almost linearly out to the limits of the main body but beyond, in the extremely faint extensions, it decreases steadily until eventually it is barely perceptible. The data furnish the first clear suggestion of solid body rotation in the main body, and planetary rotation in the extreme outer regions.

Some of the significance of these new results arises from the fact that our own system is presumably a late type spiral, similar to M33. Hitherto, there has been an apparent contradiction between the current, very plausible conception of differential galactic rotation, and the observed solid body rotation in the main bodies of the other nebulae. Dr. Mayall supplies a possible solution to the difficulty—it is only necessary to place the sun outside the main body of our stellar system—a plausible interpretation because we already know that the sun is at a great distance from the center of the system.

Future investigations along these lines will endeavor to establish normal rotational patterns at successive stages along the system of classification, and to extend them, where possible, to the extreme outer regions of the nebulae.

Meanwhile, there are some curiously

baffling rotational problems, which may be solved in the near future. We do not yet know the direction of rotation—whether the spirals trail their arms or push the arms ahead. We do not know whether the points of ejection, if they actually exist, rotate with the nebulae or remain fixed in space, and, in the barred spirals, the same question applies to the bars. Until these apparently simple problems are solved, discussion of the origin and development of spiral structure will necessarily remain in the realm of speculation.

The first problem is especially baffling. Rotations are derived from radial velocities along the major axes of tilted nebulae. An object seen edge-on is the most favorable case; it is easy to determine which end of the image is approaching, and which is receding, with respect to the nucleus. However, because the nebula is edge-on, it is not possible to detect the spiral pattern. When nebulae are tilted so the spiral patterns can be observed, it is curiously difficult to determine the direction of the tilt—whether the top or the bottom of the image is on the near side of the nucleus. In general, a definite answer can be given only when lanes or patches of obscuration are silhouetted against the nucleus itself.

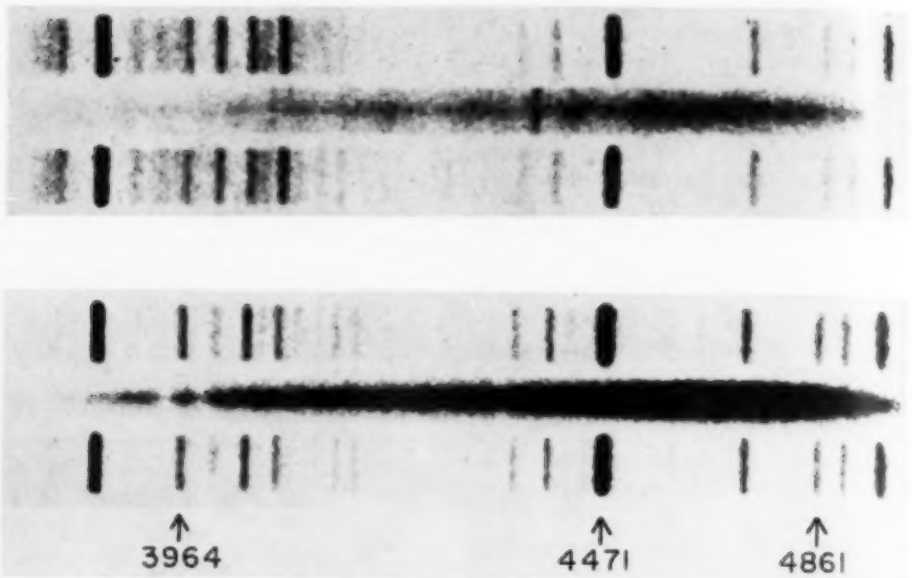
A recent exhaustive search among the 1000 brightest nebulae in the northern sky has led to a meagre list of three probably decisive cases. One has already been investigated, and, if the other two prove to be consistent, the problem may be solved. A similar search among barred spirals has isolated two or three nebulae in which the rotation of the bars can be tested. Thus, it seems likely that a firm empirical basis for theoretical investigations of spiral structure will shortly become available. The results will evidently form significant contributions to the ultimate problem of evolution.

Masses of Nebulae

The problem of nebular masses is in much the same state. The data are few, and their interpretation is confused but a way now seems open, and the solution is largely a question of time. Rotational patterns, or, at least, velocities of rotation in the extreme outer regions, may be expected to indicate masses once the patterns are fully interpreted. Meanwhile, it is possible to derive statistical orders of mass from the relative motions in pairs of nebulae. The problem is similar to that of double stars, and the same methods can be applied. However, a preliminary solution, based on about 20 isolated pairs, proved to be indeterminate because the differences in the radial velocities of components were so small in comparison with the errors of measurement that the mass effects could not be isolated. This result suggests an upper limit for the possible order of mass but furnishes no information concerning the actual order.

The next step is already under way, namely, the redetermination of the motions, using larger scale spectra for brighter objects, and multiplying the number of small scale spectra for fainter objects. The improved data will necessarily accumulate slowly. At the moment, the first 10 pairs suggest that the average mass of isolated nebulae is not likely to be greater than 10^{10} suns but, of course, the data are too scanty for confidence in this result.

Another approach to the problem is offered by the velocity dispersion, or range in velocities, observed within particular clusters or large groups of nebulae. The method was first applied by Zwicky, and, later, by Sinclair Smith, but the great increase in the number of radial velocities, due largely to Humason in the case of the clusters, and to Humason and Mayall in the case of the groups, suggests a reexamination. For instance, 55 velocities have been measured in the



RED SHIFTS, LARGE AND SMALL

THE UPPER SPECTRUM IS THAT OF A FAINT NEBULA IN THE BOOTIS CLUSTER (DISTANCE, 250 MILLION LIGHT YEARS), SHOWING THE LARGEST RED SHIFTS DEFINITELY ESTABLISHED. THE CALCIUM PAIR, H AND K, ARE SHIFTED FROM THEIR NORMAL POSITION NEAR 3964 TO ABOUT 4471, AND THE *G*-BAND, 4308 ±, APPEARS NEAR 4861 (Hβ). THE SHIFTS CORRESPOND TO AN APPARENT VELOCITY OF RECESSION OF 24,500 MILES PER SECOND. THE EMISSION LINE TO THE LEFT OF 4471 IS THE 4358 LINE OF MERCURY, REFLECTED BY THE SKY FROM THE VALLEY LIGHTS. THE LOWER SPECTRUM IS THAT OF NGC 3898, IN WHICH THE LINES ARE SLIGHTLY DISPLACED TO THE RED, INDICATING AN APPARENT VELOCITY OF RECESSION OF ABOUT 700 MILES PER SECOND. BOTH SPECTRA WERE RECORDED BY HUMASON ON A SCALE OF 500 A/MM AT Hγ. THE COMPARISONS ARE HELIUM, HYDROGEN AND NEON.

Virgo cluster, 30 in the Ursa Major cluster, 15 in the Coma cluster, and from 4 to 8 in half a dozen other clusters and groups. The dispersion clearly increases with the concentration of the cluster, as it should according to the known principles of dynamics, and reaches the extraordinary value of 1100 km/sec, found by Humason in the Coma cluster. The best determined dispersion is that for the Virgo cluster, 700 km/sec, also by Humason. The remaining values run from 150 to 500 km/sec.

The data suggest average masses of cluster nebulae of the order of 10^{12} suns or greater, and appear to be inconsistent with the tentative orders suggested by the isolated pairs and (provisionally) by the rotation patterns. Thus the problem of nebular masses is still in a highly unsatisfactory state. Nevertheless the problem may be regarded as in the process of solution. At any rate, the work must be pushed much further before theories to account for apparent discrepancies will be justified.

The Observable Region

In conclusion, we may consider briefly the progress in studies of the Observable Region as a unit. Here again, the preliminary, static description, based on the approximate distance scale, is already available. On the large scale, the distribution of nebulae appears to approximate uniformity. In particular, no sig-

nificant "gradients" have been established, there is no clear evidence of a "super-system," and, for broad statistical purposes, we may describe our sample of the universe as homogeneous and isotropic.

On the other hand, the small scale distribution of nebulae reveals a conspicuous tendency towards clustering. Nebulae are accumulated into clouds, clusters and groups of various sizes down to triples and pairs. Isolated nebulae are found, but they are the exception rather than the rule. Among the northern nebulae brighter than the 13th magnitude, about one in 8 may be considered as an isolated system. It is only when immense volumes of space are compared, in which the populations are much larger than single clusters, that the large scale uniformity begins to dominate.

This type of distribution evidently has real cosmological significance. Although the interpretation of the data is still uncertain, it seems possible that disciplined speculation, following the methods of multiple hypotheses, may throw some light on the controversial problem of the time scale. For instance, we might start from the alternative hypotheses, first, that the nebulae are clustering by capture out of an originally random distribution, or, second, that the nebulae are evaporating from clusters to populate the general field. In either case, solutions of the theoretical problems, on various sets of assumptions, will necessarily introduce the time scale. If it should prove possible to exhaust the available assumptions, the solutions might pin the time scale between definite limits. Zwicky has already discussed some phases of the first hypothesis, and, incidentally, has posed some embarrassing questions for the proponents of a rapidly expanding universe.

The dynamical picture of the Observable Region has not changed much in the last few years. New spectra, of improved quality, have confirmed the law of red shifts as previously formulated. The shifts (or apparent velocities of recession) remain strictly proportional to distance, within the uncertainties, out to the very limit of the observations. Humason has recently pegged the last reliable point on the relation with a fine 2-prism spectrogram of a nebula in the Boötes cluster. The apparent velocity of 39,000 km/sec confirms the earlier estimates, based on very small scale spectrograms, and establishes the point beyond question. The H and K lines are shifted more than 500 angstroms, and the ultraviolet spectrum has moved into the photographic range.

A critical review of previous investigations of the apparent distribution of nebulae leaves unchanged the conclusion concerning the interpretation of red shifts. No effects of expansion—no recession factor—can be detected. The available data still favor the model of a static universe rather than that of a rapidly expanding universe. In order to preserve the concept that red shifts measure expansion, it would be necessary to suppose that the postulated effects of expansion—the fading due to rapid recession—are actually present, but are nicely compensated by still another postulated effect—say strong curvature of space.

This statement presents the conclusions indicated by the available data. However, the most significant of these data lie at the extreme limits of the telescopes, where hidden systematic errors are ever lurking. For this reason, the evidence must be regarded as suggestive rather than conclusive, and the final solution must be referred to the 200-inch reflector now nearing completion.

The problem is still more confused by accumulating evidence which suggests that the law of red shifts does not operate within the local group—that is to say, within the gravitational field of a

group of nebulae. If radial velocities of the group members are not corrected for red shifts, the members appear to be nearly at rest with respect to one another —the group is stable. If the corrections are applied, the group appears to be rapidly expanding—a most unlikely behavior because such groups are too numerous to be regarded as temporary associations. This result seems to favor an expanding universe—the theory that the universe is expanding but, locally, the force of expansion may be overcome by the gravitational attraction of a group or cluster of nebulae. Thus, at the moment, the available evidence concerning the interpretation of red shifts is conflicting.

To summarize; a satisfactory preliminary description of a large sample of the universe has been sketched during the last 15 years, and the sample may be fair. An approximate distance scale has been established, and we know the general cosmography of the region, together with the structural forms of nebulae and the brighter elements of their contents.

The second phase of the investigations, the study of dynamical aspects or behavior of the universe, has been initiated, and is gathering momentum. Various fundamental problems have been formulated, and, for many, the ways to the solutions have been opened. A few of the problems have already been solved. But one essential datum, namely, the time scale, remains speculative, and, at the moment, we see no direct line of attack.

The immediate outstanding problems are, presumably, the interpretation of supernovae, of spiral structure and of red shifts.

THE PROGRESS OF SCIENCE

"Two hundred and forty years," I hear some one say, "what are they in the development of a nation, or of its scientific character? Twenty-five centuries have passed since Thales predicted an eclipse of the sun; nineteen, since Sosigenes reformed the calendar for Julius Caesar; fourteen hundred years have rolled over the University of Bologna. What to you occidentals seems a hoary antiquity is a mere yesterday for the dweller by the Tiber, the Thames, the Seine, the Danube or the Rhine." Be it so! Yet Hans Lippersheim's first suggestion of a telescope was eighteen months after Newport had sailed up the James River with his infant colony. The idea of a logarithm was then not born: Napier and Briggs were names unknown to fame. The oaks and beeches had been cleared from these hills, and our ancestors had built their rustic homes, at the time when Galileo was tortured into adjuring the profane doctrine that the earth moved, and not the sun. When Harvard endowed the college that bears his name, there was no such thing as a barometer or a thermometer. It is within these very two hundred and forty years that modern science has come into existence, and the world's intellect been turned from speculation to investigation. It is within this period that our implements of research have been devised, that the air-pump, the electrical machine and the clock have been invented, that every public chemical laboratory, every astronomical or physical observatory, and every academy of sciences has been founded. Boston had been settled when Keppler died. The grandchildren of the original colonists of Plymouth and the Massachusetts Bay were born, when the law of universal gravitation was first proclaimed by Newton.

Therefore it is that we must confess our scientific progress to have been far inferior to that of several European nations. And I fear that the confession might truthfully be made much broader, and include our progress in all purely intellectual studies, which hold forth no promise of immediate utility in promoting physical well-being or material convenience. If this is true, my friends, it is time that it should be so no longer. And before you, the declared lovers of science,—in this Association formed to promote her welfare and advancement,—here in the earliest seat of that colony, whence has geographically radiated what of culture and of science our country has possessed,—I would fain say some few words which, however crude or ill-arranged, might find a congenial soil within your hearts—to bear fruit, perhaps, when all of us have disappeared from the stage—and which might aid, in however small a degree, to avert the day when the highest recognized aims shall be toward material prosperity, rather than toward intellectual development and progress—*Benjamin Apthorp Gould (astronomer) Presidential address before the American Association for the Advancement of Science, Salem, Massachusetts, August, 1869.*

SOME ASPECTS OF CENTRAL AMERICAN BIRD-LIFE

I. FAMILY LIFE IN A NON-MIGRATORY BIRD POPULATION

By Dr. ALEXANDER F. SKUTCH
SAN JOSÉ, COSTA RICA

I

AFTER a decade devoted largely to the study of the habits of the Central American birds, it seems to me that the most fundamental and far-reaching difference between them and the birds of a region of great annual fluctuation in temperature, such as eastern North America, is that the majority of the tropical species dwell in the same localities throughout the year, while those of the temperate zone are, on the whole, shifting and migratory. I believe that the chief biological differences, as opposed to those of specific composition, between the bird populations of these two regions are related closely to the extent of their annual wanderings. And these, of course, are tied to the circumstance that in a region where snow and long-continued killing temperatures are unknown, the majority of birds find sufficient food on their breeding ground the year around; while in the so-called Temperate Zones, winter's dearth and barrenness send them afar in quest of sustenance—to another farm, another state, another country or another hemisphere.

A not inconsiderable proportion of the species of birds which occur in Central America are migrants which breed in the countries to the north. Whether these are North American birds which come south to escape the winter, or Central American birds that travel north to breed, is a question we need not attempt to settle here: suffice it to say that the majority of them spend, as species, from half to nearly three quarters of the year in the tropical portion of their extended range.

Of land birds which breed in Central America, I know only four species that perform migrations at all comparable to those of the great host of visitants from North America. In the parts of Central America north of Panamá, three flycatchers and a vireo arrive in February or March from the south, raise their families, then withdraw southward in September or October, if not earlier. One of these migrants is the sulfur-bellied flycatcher (*Myiodynastes luteiventris*), individuals of which go as far north as Arizona to nest; another, the noble flycatcher (*M. maculatus*) is very closely related to the first. The third is the striped flycatcher (*Legatus albicollis*), which has the disagreeable habit, apparently unique in its great family, of throwing out the eggs from the nests of other birds which build roofed structures, and using these stolen homes for its own offspring. The last is the yellow-green vireo (*Vireosylva flavoviridis*), a species exceedingly similar to our migratory red-eyed vireo.

In a region with extensive highland areas, and mountains rising up to heights of twelve and thirteen thousand feet, a certain number of birds perform seasonal altitudinal migrations. The Costa Rican bell-bird, which breeds in the highlands chiefly above five thousand feet, wisely avoids the worst of the drenching rains and chilling cloud-mists which assail these cold, wet heights, by descending during the rainy season into the adjacent lowlands. Hummingbirds of certain kinds, too, are seasonally abundant at certain levels in the highlands, usually when there is a profusion of flowers, and afterwards disappear. With so few observers

in the region, it is difficult to trace their movements.

But the majority of highland birds remain the year about at the altitudes at which they breed. I once spent a year watching birds on a certain mountain in Guatemala, where in the cypress forest above nine thousand feet the Guatemalan golden-crowned kinglet, a resident race of the familiar northern bird, was abundant; yet not once during the entire year did I see a single kinglet as low as 8,500 feet, at which level most of my bird-watching was done. This experience has been paralleled time and time again in the most varied localities with many species of birds; each has definite altitudinal limits above and below which it does not pass. Of two species which mingle at sea-level, one may range upward to eight thousand feet, while the other, less tolerant of lower temperatures, stops short at two thousand; but once the upper limit of the species has been ascertained, one will look in vain to find it higher.

Another class of local migrations of tropical birds is well exemplified when, at the time of blossoming of the *guavo* (*Inga*) trees which shade the coffee plantations, hummingbirds and honeycreepers gather in great numbers to probe the clustered, white, powder-puff blossoms. Many of these, especially the former, may be of kinds which at other times are rare or absent from the district. Especially memorable is the great concentration of blue honeycreepers (*Cyanerpes cyaneus*) in the coffee plantations on the Pacific slope of Guatemala in December and January. From just how far these nectar-loving birds gather remains unknown.

But the species which wander in one or another of these modes are at best a small proportion of the whole Central American avifauna. The great majority of the Central American birds are sedentary to a degree difficult to be conceived by one familiar only with the shifting bird populations of higher latitudes. Not only does each species (with few exceptions) remain within fixed altitudinal bounds, but many are very closely attached to their own peculiar habitat, which they seldom voluntarily quit. There are numerous species of the heavy forest which scarcely ever venture beyond its shadow; while the denizens of the clearings may never penetrate as far as a hundred yards into the adjacent heavy woodland. Month after month through the twelve, one finds the same birds in the same thicket, the same field or the same forest. In a number of cases, while studying sleeping-habits, I have found the same individuals passing the night in the same spot throughout the year. The most striking periodic differences in the general complexion of the bird-population of any region of Central America are caused by the autumnal influx of the migrants which breed in the north, and by their departure in the spring.

II

In regions where winter is severe, the necessity to travel afar in search of food breaks up family groups at the end of the breeding season, for males and females, old and young, may have their separate times for beginning their journey. Or, if the birds remain in their nesting territory the year around, then the difficulty of finding sustenance during the cold and barren months causes the mates to separate, the struggle for individual existence proving stronger than conjugal ties. Thus it is said that in England the male and female of a pair of robins may occupy adjoining territories during the winter months, each opposing trespasses of the other until spring's mildness draws them together once more. Apparently the same may sometimes be true of the mockingbird in the United States. I am not sure that any species of the Middle Atlantic States—the temperate zone re-

HUMID LOWLAND FOREST ON THE CARIBBEAN FOOTHILLS, HONDURAS
THE HOME OF TROGONS, TOUCANS, ANTBIRDS, MANAKINS AND HUMMINGBIRDS.

COVERED NESTS OF CENTRAL AMERICAN BIRDS

Left: PART OF A TREE-TOP COLONY OF MONTEZUMA OROPÉNDOLAS (*Gymnostinops montezuma*), LARGER RELATIVES OF THE ORIOLES. *Right:* ROOFED NEST OF THE YELLOW-BREASTED CHIPSACHEERY FLYCATCHER (*Myiozetetes similis*), A COMMON BIRD OF THE LOWLAND CLEARINGS.

gion with which I am most familiar—actually remain mated over the winter. I suspect that Carolina wrens, and possibly white-breasted nuthatches, may at times pass the winter in pairs, but lack sufficient evidence to make a positive assertion. Unfortunately, since I became especially interested in this point, I have had very little opportunity of making observations outside the Tropics; and this is a point to which ornithologists in general have failed to devote the attention it merits.

But northern birds which remain mated through the year are certainly exceptional; while in Central America the kinds which do so are numerous. Not only do the male and female remain together, but in many cases they are almost inseparable, so that adult birds of the species are almost always seen two by two; or, if they are out of sight of each other, they keep in contact by their voices. When the species haunts densely entangled thickets where visibility is poor, it is often by the ear alone that the bird-watcher can convince himself that a certain bird, a kind of which he is fortunate to catch a fleeting glimpse of a single individual, lives in close association with a mate.

In a number of localities of Central America, both highland and lowland, I have made lists, based upon prolonged observation, of the species which live in pairs during the months when they do not nest. These include many species of tanagers, finches, wood warblers, wrens, flycatchers (Tyrannidæ) and woodpeckers; a few antbirds (Formicariidæ), ovenbirds (Furnariidæ) and motmots; two woodhewers (species of *Lepidocolaptes*); and the only gnatcatcher (Sylviidæ) for which I have sufficient observations. Orioles (Icteridæ) usually flock; in this family only Prevost's

OPEN NESTS OF CENTRAL AMERICAN BIRDS

Left: FEMALE NIGHTINGALE-THRUSH (*Catharus frantzii*) IN HER MOSSY NEST, HIGHLANDS OF GUATEMALA. *Right:* FEMALE CRIMSON-BACKED TANAGER (*Ramphocelus dimidiatus*) INCUBATING HER TWO EGGS, ISTHMUS OF PANAMÁ.

cacique (*Amblycercus holosericeus*) is on my list of birds which remain mated. I am certain of no thrushes which remain in pairs; but nightingale-thrushes (*Catharus*), of which there are numerous species, denizens of low and tangled vegetation, are exceedingly difficult to observe. Toucans usually flock; but I have known a pair of araçaris (*Pteroglossus frantzii*) to sleep together in old woodpeckers' holes through the year. Parrots and macaws, although they sometimes aggregate into great flocks, appear to remain mated, for the individuals which form these flocks, in certain species at least, fly and sometimes roost two by two, with usually some noisy and quarrelsome groups of three: triangles which remain to be squared.

Of great interest are the vocal sounds by which these constantly paired birds keep in contact with each other. For many of them a simple, sharp, characteristic call-note of one or two syllables does not suffice; their mutual affection and dependence on each other seeks expression in more complex utterances, common among which are churrs, trills and various other types of musical phrases. The male and female of some kinds, when they come together after a brief separation, greet each other with special utterances, sometimes of a peculiar, indescribable nature, at other times so musical that they have deceived me into believing that I heard the true song of the species. Some kinds of wrens, indeed, seem to lack true call-notes, although their vocabularies include a number of scolding and warning phrases. With them song is developed to a high degree as a means of keeping the pair together. Both male and female sing, frequently in antiphonal fashion; and singing back and forth to each other in rapid alternation, the voices of the two are so accurately

RIO CHIRRIPÓ AND WEST PEAK OF CHIRRIPÓ GRANDE (12,580 FEET), THE HIGHEST SUMMIT BETWEEN GUATEMALA AND COLOMBIA.

synchronized and harmonized that it is only when the hearer happens to stand between them, and hears their notes come now from one side, now from the other, that he can convince himself that he is listening to more than a single sweetest songster. The phrases of the male are usually somewhat longer and richer in tone than those of his mate. Doubtless it is because the constantly mated pair keeps in contact by song, rather than by simpler sounds, that wrens, more than all other birds, sing throughout the year. Most curious are the responsive utterances of the Prevost's caciques, jet-black icterids with sharp yellow bills, that haunt the densest thickets of the lowlands. The beautiful, mellow whistles of the male are answered by the female with a long, dry *churr*, as different as could be from his rich, round notes. It is only because I have, at all seasons, heard *churr* answer whistle that I feel sure these birds remain constantly mated: the ear is of more service than the eye in studying the ways of birds so retiring as these.

Lest the foregoing paragraphs leave a one-sided impression in the reader's mind, it may be well to add that in tropical America there exist several distinct groups of which the individuals never pair, and of which the males consequently take no share whatever in the care of nest and young. Notable among these are hummingbirds and manakins, of which the males in many species have very specialized habits of courtship, confining themselves during the breeding season to certain definite locations, which by their calls or antics, or both together, they make known to the opposite sex. Usually a number of males of the same kind, so calling or displaying, are grouped together into a courtship assembly, in which each individual has his own particular station; and these stations are mutually respected by the members of the group. Certain cotingas and forest-haunting flycatchers fail to pair; and the males of

some of these call for months on end from the same station. In certain members of the oriole family, including oropéndolas, caciques (*Cacicus*), and the great-tailed grackles, the females are far more numerous than the males, a situation which among birds usually gives rise to polygamy. The females of these species build their nests in populous, crowded colonies; the males keep watch over the nests and sound the alarm at threat of danger, but otherwise lend no assistance in the breeding operations.

III

As a result of their generally sedentary mode of life; of the habit of many kinds of remaining paired throughout the year; of the adoption by other species of modes of propagation which make unnecessary the competitive acquisition of mates, the Central American birds on the whole seem to lead more tranquil existences than the feathered folk of extra-tropical lands. Although quarrels and fights certainly do occur among them, these appear to be of a milder and less hotly contested nature than those between birds of higher latitudes at the outset of the breeding season. The literature of north-temperate ornithology, especially that concerning territorialism, contains no lack of accounts of conflicts to the death between birds of the same or of different species. In the course of my own bird-watching, the preponderant part of it in the Tropics, I have never once seen one bird kill another in conflict, or even inflict serious injury upon another—excepting, of course, predatory species which kill for food. Only once have I seen a bird draw blood from another of its own kind.

Where birds have the entire year in which to adjust conflicting territorial claims, to settle amorous disputes, they may gradually come to an understanding without resort to violence. Where birds, arriving from afar, must claim their breeding territories, win their mates, build their nests and raise their young, all during a relatively brief season of

AUTHOR'S RESIDENCE IN RIVES DE PÉREZ ZELEDÓN, 1935–1937

VIOLET-EAR HUMMINGBIRD (*COLIBRI THALASSINUS*)
FEEDS HER NESTLINGS IN THE REMAINS OF THEIR NEST IN A CYPRESS TREE, HIGHLANDS OF GUATEMALA (9,700 FEET). THE MOSSY CUP HAS BEEN BURST ASUNDER BY THE PRESSURE OF THE GROWING NESTLINGS.

favorable weather, greater haste in the adjustment of disputes is imperative; tempers become overstrained; and fierce, sometimes fatal, encounters ensue. In human society we find an almost exact parallel to this situation. In long-settled, well-organized communities, acts of violence are far less frequent, in proportion to the population, than in pioneer settlements where property and personal rights are less firmly established; certainly the history of our own country gives abundant proof of this. Now the Central American birds, all in all, form a settled, static and generally peaceable community; the birds of an area in the temperate zones, with each returning spring, are a community of newly arrived pioneers, who only by strife and conflict adjust their differences and shake down into some sort of social order. Competition is no less keen in an old than in a new community; on the contrary, it is likely to be keener; but it acts in more subtle, less violent ways.

Perhaps some of my readers may recall that hummingbirds, a family represented in Central America by several score species, have a reputation for great pugnacity. Certainly no one can long watch these brilliant sprites without beholding one dart with apparent fury at a neighbor. But the object of the attack almost invariably takes flight; and there ensues a spirited pursuit, so rapid that the human eye can scarcely follow. Yet I have never known one hummingbird to inflict bodily injury upon another. I can recall only once having seen a hummingbird stand his ground as another dashed upon him. The two collided almost as lightly as two volitant tufts of thistle-down, and with results no more injurious to either. After years of attentive observation of hummingbirds, I am unable to decide whether they are the most pugnacious,

or the most playful, of our birds; but I suspect it is the latter. Surely their mode of courtship, where a number of competing males assemble to sing month after month within sight and hearing of each other, each on his chosen perch, would be impossible if they carried murderous intentions in their hearts. Even greater amity prevails in the courtship assemblies of manakins, and such flycatchers as Pipromorpha, for these apparently never even make pretense of attacking each other, but behave with a decorum and respect for the rules of the game which men might well envy.

Among the colonial-nesting Icteridæ—oropéndolas, caciques and grackles—it seems to be good breeding for the male who sees himself pursued by another to make a dignified retreat, leaving his perch free to the latest claimant for it. Thus these unoccupied males amuse themselves without serious dissensions; and in a good deal of watching of colonies of all three of these groups, I have rarely witnessed a flare-up between the males, never a real fight. The females, building their nests in close contact, sometimes fray each other's nerves, lose their tempers and set at each other with bill and claw; or else fights arise between them when one, too lazy to fly afield for more building material, attempts to pilfer it from a neighbor's nest, or even her very bill. But I have never known these squabbles to have serious consequences; and in the end the two females, who have quarreled so frequently while building their nests, settle down to incubate their eggs amicably side by side.

Most delightful to watch are the little Mexican grassquits (*Tiaris olivacea*). At the height of the breeding season one may see four or five males trilling sweetly in the same small bush, all in the best of humors. Yet the territorial instinct is by

BIRDS OF THE CENTRAL AMERICAN HIGHLANDS

Left: A FEMALE QUETZAL (*Pharomachrus mocinno*) AT THE ENTRANCE OF THE NEST CAVITY, ABOUT TO DELIVER A GOLDEN BEETLE TO THE TWO NESTLINGS. *Right:* NEST OF THE BLACK-EARED BUSH-TIT (*Psaltriparus melanotis*) WITH FOUR MALE FLEDGLINGS, HIGHLANDS OF GUATEMALA.

no means dead in these tiny finches. If one of them venture too near the nest of another, the owner will invite him to depart simply by flying toward him; and I have never known the trespasser to resist this mild suggestion that he is intruding, and make necessary a resort to force. On the other hand, a few of the Central American birds are notably pugnacious, outstandingly so the little, angry Lawrence's elænia (*E. chiriquensis*) of southern Costa Rica and Panamá. One morning, when I was sweeping out my cabin in the Valley of El General, one of these flycatchers, hotly pursued by a rival, brushed past me in the open doorway, and took refuge in a corner of the room. Yet although the *copetoncillo* is perpetually quarreling with his neighbors, I have never known him to inflict upon them damage greater than the loss of a few feathers.

Mildness of temper, then, seems to be a characteristic of the Central American birds, as a result—so I interpret it—of their leisurely, unhurried manner of life. I might fill many pages with personal observations in proof of this, but must content myself with one concerning that most original avian character, the Costa Rican tityra (*T. semifasciata*), a member of the cotinga family. Their nearly white plumage trimmed with black, their bare red cheeks, their thick black bills and their bizzare grunty voices, make them unmistakable in the Central American avifauna. For some weeks past, I have been watching a dispute between two pairs for possession of a tall dead tree which contains sufficient old woodpecker holes for the nests of both; but they are "territorial" birds, and the two will not breed so near each other. All four rest among the leafless branches; after an interval of repose one begins to grunt and twitch its tail in an excited fashion, then darts at a member of the other pair, who at once flits away. For a few moments they dash confusedly about, rarely so much as touching each other. Then, the brief flare-up over, they settle down to rest amicably side by side once more. Soon all four wing away in company to forage in the tops of the forest trees; after an interval they return together to resume their interrupted discussion. Thus they have whiled away the latter part of the breeding season, apparently deriving considerable diversion from their long-protracted argument, for it is resumed from time to time even now when it is very unlikely that either pair will nest this year in the contested tree. They have, of course, failed to reproduce their species—unless they raised very early broods elsewhere. But this is just as well, for if they are already so numerous that they can not all find cavities in which to nest—they are incapable of carving them out for themselves—they would only be creating worse difficulties for their kind if they increased their numbers. This is one means of avoiding that most pernicious disease, overpopulation.

ANT MOUNDS IN WINTER WOODS

By Dr. E. A. ANDREWS

EMERITUS PROFESSOR OF ZOOLOGY, THE JOHNS HOPKINS UNIVERSITY

THE little ant hills of our garden walks disappear with bad weather, but the mound-building ant of the Eastern States, technically known as *Formica exsectoides* F., is able to gather and fabricate a ton or so of materials into a permanent home enduring through many winters.

When, in midsummer, we pause to watch the hundreds of ants busy on such a mound building and repairing it, we may at first overlook the fact that all roundabout are many more ants going and coming, foraging for food, but also, we find, prone to stop and test us with jaws and formic acid, fearing neither beast nor man.

In winter all is changed; we find no ants; the snow falls upon the mound as upon other objects and the ants are not roused by it as they are by the falling summer shower. Are the ants perhaps indoors enjoying a long Thanksgiving feast after the heavy labors of the summer time?

When the sun comes forth and falls upon the south slope of one of these mounds it soon melts the snow away so that, as in Fig. 1, we find the south face quite bare while yet the north face is white with snow. While this is but the familiar sun effect upon the plowed furrow that may be slimy mud on the south while yet frozen stiff on the north, in the ant mound the conical form makes the result very striking, indeed, just one half being white and the other brown. In the Alps natives found their way in the fogs by using certain ant mounds as compasses, since these were built by the ants more on the south, and in the same way many of our American ant mounds show differences between the north and the south faces. In the winter, however, we do not need the response of the ant to the sun in being more active on the sunny slope, but we can see at once from the sun effect where the compass points must be, even in the night time. Thus, as seen in Fig. 2, when the brown side is to our

FIG. 1. WHEN THE SNOW COVERS THE EARTH

THE SOUTH FACE OF AN ANT MOUND MAY BE SUN WARMED TILL QUITE BARE THOUGH THE NORTH FACE STILL STAYS WHITE.

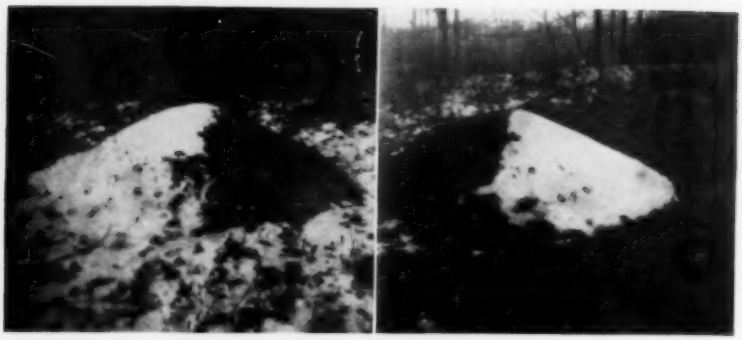


FIG. 2. MOUNDS IN FEBRUARY

ONE HAS THE SNOW MELTED OFF ON THE SOUTH FACE, TO THE RIGHT AS ONE LOOKS FROM THE WEST; THE OTHER SHOWS SNOW STILL LEFT ON THE NORTH FACE, TO THE RIGHT AS ONE LOOKS FROM THE EAST.

right we are approaching the mound from the west, and when on our left we are coming from the east.

But what has become of the ants which made these mounds so that records of compass directions are left for those who will use them? When the soil is loose, digging into such a mound is easy, but when long rain and frost have made it hard we may need a saw to cut into it as into an old-time sugar loaf.

FIG. 3. THOUGH THE SUN HAS MELTED THE SNOW TILL THE WOODS ARE BARE THE ANT MOUND SEEN FROM THE NORTH STANDS OUT LIKE A PURE WHITE TENT.

Watching the ants in the fall we saw that, unlike men, who may move the more briskly as winter approaches, the ants move more and more sluggishly, but persist in working at the mound repair, even on into November if not too cold, gradually retiring day by day till few and then none are left above ground. Yet in our digging we do not find the ants in all the innumerable angles and turnings of the immense labyrinth that forms a continuous network of passageways through the mound—many parallel to the surfaces of the mound, many somewhat in stories connected by numerous "ramps." All much alike with no main halls. Nowhere are there ants to be seen till finally in the solid earth under the mound a few shafts descending from the network of passageways lead down deep into the subsoil and there in the cold and wet we dig out masses of ants—red and black bodies with intermingled legs oozing out of the narrow tunnels as if under pressure. Such ants are alive but scarce able to move. No longer running as they did at the rate of one mile in five or six hours when the thermometer stood at 86° F. or even in twenty-four hours when at 50° F. Now, at temperatures near freez-

ing, the ants stagger slowly along; yet if warmed and fed they remain active enough. Their life depends upon warmth and this comes to them from the sun.

Stores of food laid up in the ants' dwelling we do not find: apparently the ants go hungry nearly half the year through. However, the grasshopper perishes, while the ant lives through the winter, having made for itself a safe retreat where few enemies, even bug hunters, will penetrate.

As spring draws near the snow may still long linger on the north slopes of ant mounds, so that while from the south they do not show well against the brown leaves of the forest-floor yet from the north the mounds shine from afar, as if white tents (Fig. 3).

Eventually even this north cloak of snow melts and the sun heat penetrates deeper into the mound, arousing the ants, some of which venture up before others, sensing the differences between the cold below and the warmth above and seeking the warmer place, as in the fall they went down toward the stored-up warmth the sun had accumulated deep in the soil.

Coming out of their cold wet "go downs" the spring ants bask in the sunshine but soon set to work to repair the mound, washed by the winter storms, cracked with frost or even with dryness. Repair is proportional to need; holes made by feet of animals are filled in; even half mounds shovelled away by human fire-fighters may be restored completely by the hard-working ants. Soon, however, food begins to be found, stray insects and the first drops of honey-dew as the leaf buds begin to unfold. As the sun mounts higher day by day the ants' activity increases and breeding begins.

Children of the sun are these ants, building a house into which enters the sun as partner in their successes.

CHEAP BOOKS

NINE great publishing houses have decided to meet the "menace" of cheap books by publishing cheap books themselves. Cape, Cassel, Chatto and Windus, Collins, Dent, Faber and Faber, Heinemann, Harrap and John Murray are members of the new British Publishers' Guild, set up to sell books at 6d., 9d. and 1s. It is an attempt to restore the stability of an industry that has lately made very heavy weather economically, and a recognition of the merits of centralized and rationalized methods, both in production and distribution. The basis is co-operative effort. The whole stock of guild books will be delivered to the Book Centre, a limited company which will pack, invoice and dispatch the books to customers. In tune with modern business trends, a standardized and price-maintained article will emerge in the book world.

The new enterprise, still only very small and in embryo, is clearly an attempt to "cash in" on the gigantic sales made by the pioneer producers of sixpenny books—40,000 to 150,000 copies of each Penguin and Pelican were sold in the first year of their publication during the period 1935 to 1938. It is designed to thwart this rivalry by meeting it on its own ground. By issuing and maintaining "a first-class list of cheap editions," its sponsors claim, "the Guild will discourage the sale by authors and publishers of established books to organizations which have contributed nothing to their original success." This is the gravamen of the publishers' grievance against cheap books—as it always has been. Their contention is that names and titles "made" by their efforts are exploited to the advantage of others—a charge which loses some force by the fact that an appreciable number of the latest cheap books are original works or by unmade authors. . . .

That is what appears to be happening now. Publishers seem to have recognized, at last, that they can not swing against the stream; and that sixpennies are not merely a flash in the pan and economically unsound. They are a new and likely line of business. So, tentatively and with reservations, the publishers are going to adopt the principle which for so long they have fought against as being contrary to all good publishing traditions and trade ethics. This, and the failing financial vitality of the book industry, make up the background of the British Publishers' Guild. The regular publishing trade is to undertake the publication of special books at cheap prices, and their pooling of resources will create a great undertaking. It is the method of the cartel and centralized selling to protect a limited monopoly; but it is certain to meet sharp and efficient competition from the irregulars who have carved out a new market with skill and discernment. The public should gain by more and cheaper books, the community as a whole by more readers, and the book trade itself by new life after a long time in set ways and habits.—*The Economist (London)*.

MICROBES IN A CHANGING WORLD[1]

By Professor SELMAN A. WAKSMAN

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THE role of microbes in the economy of nature was clearly foretold toward the end of the eighteenth century by the great chemist Lavoisier, to whom we are indebted for contributing to a better understanding of one of the most important reactions of the living system, namely, that of respiration. He said:

> Plants thrive at the expense of the air that surrounds them, of the water, and of the mineral kingdom from which they obtain materials essential for their organization; animals obtain their nutrition from plants, or from other animals also nourished by plants, so that matter thus produced is aways formed from the air and the mineral kingdom; finally, the processes of fermentation, putrefaction and combustion continuously return to the air and to the mineral kingdom those principles which have been removed by plants and animals. By what processes does nature bring about this marvelous cycle between the three kingdoms?

Fourscore years later (1862), Pasteur, emphasizing the remarkable insight into the processes of nature by Lavoisier, proceeded to disclose the secrets of the third process least understood at that time. He emphasized that "The destruction of the dead organic matter is one of the necessities for the continuation of life. If the débris of plants that ceased living, as well as of dead animals, were not destroyed, the surface of the earth would become covered with organic matter, and life would become impossible, because the cycle of life could not be completed." The link in this chain of life was found to be formed by microscopic organisms which, in the process of multiplication, bring about the destruction of complex organic materials by means of slow combustion accompanied by the consumption of oxygen.

Since the birth of the new science, microbiology, another fourscore years have elapsed. Many thousands of species of microbes, varying greatly in nature, in physiology and in functions, have been discovered; many have been isolated and carefully described. They have been found to occur in large numbers in the air and in the soil, in rivers, lakes and seas, in foodstuffs and in the digestive systems of animals. They comprise both friends and enemies of man. In his struggle for existence against natural forces, man has found in them able servants, laboring continuously and helping him in numerous ways in the production of his crops, in the preparation of his beverages, in the preservation of his foodstuffs and in combating many of his enemies. Occasionally some of the microbes went on a rampage and began to attack man and his domesticated animals and plants. Man, in his conquest of nature, is coming to recognize that he may be able to make use of the friendly microbes in combating the deadly ones, the causative agents of disease.

Great progress has been made during the past half century in the field of microbiology. But even now the methods and approaches in this field of science are undergoing certain important changes, which, as many are beginning to realize, may modify the entire attitude of both scientific workers and laymen toward microbiology, in general, and the utilization of micro-organisms for human welfare, in particular. From the early beginnings of microbiology, scientists have been searching for organisms which participate in the numerous beneficial and injurious processes that affect communities of plants and animals. The knowledge thus gained has been utilized to combat the activities of those organisms which are harmful to the health and economy of man, and to stimulate those which are beneficial.

[1] Journal Series Paper from the N. J. Agricultural Experiment Station.

Comparatively little interest has been shown in micro-organisms as biological entities, even though many of their functions have become known and their activities utilized.

Since the time of Pasteur, microbiology has traveled along two distinct paths, frequently quite apart from one another: one leads to the study of diseases of man, beasts and plants; the other is directed toward the microbiology of the soil, of water and sewage, and the utilization of micro-organisms in the industries and in the preparation of foodstuffs. The second branch is frequently referred to, quite incorrectly, as the microbiology of fermentations and occasionally even called general microbiology. A large body of knowledge concerning these infinitesimal forms of life and the relation of microbes to man has thus been built up. Many of the useful organisms have been domesticated, while many harmful ones have been combated and in many cases controlled. This has resulted in a complete revolution in medical practice and sanitation, as a result of which many diseases, formerly scourges of mankind, are now of negligible importance or materially controlled. If the newly gained knowledge has not served as effectively to revolutionize agriculture and related fields, it is not due to the lesser importance of the organisms concerned, but merely because man has made use of many of their activities since time immemorial, without giving them proper credit.

In attaining these ends, the microbiologist has largely availed himself of one method, namely, that of pure culture technique. This has been due primarily to the fact that, as causative agents of disease, single organisms are usually concerned. In those instances in which microbes live in complex populations, the individual organisms have been isolated from their environment and their specific physiology studied; their functions in nature were then interpolated. A number of problems, especially those pertaining to the activities of micro-organisms in causing disease of plants and animals and their functions in various natural processes, have thus been clearly elucidated. Unfortunately, comparatively little is known of the life of microbes in their natural environment.

The soil microbiological population may serve as an instructive example. It has been definitely established that soil harbors thousands of species of bacteria, hundreds of genera of fungi, actinomycetes and algae, numerous families of Protozoa, nematodes and other worms. These organisms are widely distributed and are often counted by the millions and hundreds of millions in a single gram of soil. Some are known to be concerned in highly specific reactions, such as the fixation of atmospheric nitrogen, the production of nitrite from ammonia, of nitrate from nitrite and of sulfuric acid from sulfur. Other reactions can be performed not by a single organism but by a number of different organisms: The decomposition of cellulose in nature, a highly specific process, can be brought about by various bacteria, possessing distinct morphological and physiological characteristics, by many fungi, belonging to widely different genera, by certain actinomycetes and possibly even by Protozoa and other invertebrates. The same is true of the decomposition of proteins, hemicelluloses, starches and other organic compounds. Some of the processes take place in chain-like reactions, in which one organism uses the products of another, in which one reaction leads to another, or in which the activities of one organism depend entirely on those of others. The decompositions of proteins in the soil, in sewage and in water are a good illustration of this type of transformation.

These processes, when considered singly and separately from one another, do not elucidate fully the complexity of the natural population, with its numer-

ous interrelationships. Considerable evidence has now accumulated which serves to emphasize the fact that not only do organisms assist one another in creating favorable conditions or in preparing the required nutrients; and not only do organisms compete with one another for the available foodstuffs, but many microbes exert a variety of other effects, regarding which there have seldom been more than conjectures or unsubstantiated hypotheses. In this connection one is reminded of the production by various microbes of stimulating substances, the nature of which is still unknown; and of injurious substances, comprising both toxins and phages, as well as the actual preying upon or consumption of some microbes by others.

These phenomena are recognized only by realization of the fact that the microorganisms form complex populations in the soil, in sewage, in water and in other natural substrates. The nature of these populations depends upon the medium in which they grow and upon the environment. One substrate, under one set of environmental conditions, contains a typical microbiological population. This population has a characteristic composition and consists of microbes which have become adapted to the particular set of conditions. When these are changed, the make-up of the population is changed. Winogradsky recognized in the soil population the existence of two distinct groups of organisms, one of which he designated as the autochthonous and the other as the zymogenic group. The first changes but little and only very slowly in response to a changing environment or to added foodstuffs, whereas the second responds rapidly to such changes.

Any attempt to explain and evaluate the numerous interrelationships in a microbiological population, such as that existing in the soil or in water basins, must take a number of factors into consideration. The following competitive relations have been recognized[2] among the marine forms of life: (1) competition among diatoms for the available mineral nutrients in the water; (2) competition among copepods and other animals for the available plant materials; (3) competition among individuals of one kind or species and individuals belonging to different kinds; (4) competition among young, growing and reproducing cells, and among older, respiring cells; (5) food competition *vs.* space competition; (6) competition of transitory and permanent populations for light, space and food, and (7) sedentary or sessile organisms *vs.* free-moving forms. One can enlarge upon this list by including other factors which are prominent in non-aquatic environments such as: (8) degree of tolerance of the immune or resistant varieties and the less resistant or more sensitive forms to attack by disease-producing organisms; (9) fitness for survival of microbes that are able to become adapted to a symbiotic form of life, as in the case of the leguminous plants or mycorrhiza-producing plants, and those which are not so adapted; (10) survival of parasitic forms which require living hosts for their development, as contrasted with survival of saprophytes that obtain their nutrients from mineral elements or from dead organic residues.

How can one interpret the interactions of different organisms making up a complex population without considering all these interrelationships? Pearl[3] emphasizes that, in any discussion and elucidation of population problems, three important factors must be considered: (1) size or total number of individuals comprising a given population; (2) growth, as measured by change in a given period of time, in a positive or negative direction, and (3) quality, or the nature or specific constitution of the population. These criteria apply to microbes as well as to men. Additional

[2] W. E. Allen, SCIENTIFIC MONTHLY, 49: 111, 1939.

[3] R. Pearl, *Amer. Nat.*, 71: 50, 1937.

factors are of importance in dealing with a microbial population which is quite strictly a victim of its immediate environment; (4) nature of medium in which the organisms grow; (5) abundance and nature of available foodstuffs, and (6) environmental factors, especially aeration, reaction, temperature, and moisture.

The differences in behavior of one organism growing in a pure culture from that during its development in a mixed population are illustrated by the following three examples:

1. Pure cultures of bacteria were found to multiply in a nutrient medium until a limiting population was reached;[4] this maximum was maintained for a long time. Protozoa grew in that particular medium without bacteria only when the concentration of the food supply was increased 100 to 1,000 times; when bacteria were present, they grew also in the dilute solution. The bacteria thus acted as collectors or concentrators of the food for the Protozoa. Bacterial numbers were thereby reduced, but bacterial activities continued. Oxygen consumption increased with an increase in the number of different organisms occurring together in the culture medium. The Protozoa kept the bacteria below the saturation point, thus providing conditions for more continuous bacteria multiplication and for more complete oxidation of the organic matter. In this connection, one may recall a theory which was in great vogue some years ago,[5] according to which the fertility of soil was believed to be based upon the interrelationships between the Protozoa and the bacteria. This theory assumed that bacteria are the sole agents responsible for the liberation of the elements essential for plant growth, in available forms. The Protozoa were considered as the natural enemies of the bacteria. By destroying the bacteria, the Protozoa were believed to reduce soil fertility. According to this theory, only when the Protozoa were eliminated, as by treatment with heat and chemicals, could the normal functions of the bacteria in the soil and, therefore, the fertility of the soil be re-established.

Further investigations did not support these conclusions.[6] It has actually been shown more recently that, by consuming some of the bacteria, the Protozoa keep the latter at a high state of efficiency and thus assist in the breakdown of the plant and animal residues in the soil. In other words, the rate of transformation and even the total amount of change in the substrate is increased by the presence of Protozoa; it has been observed that where Protozoa occur together with the bacteria, such reactions as ammonia formation, carbon dioxide formation and nitrogen fixation are definitely favored. Thus, an interrelation among micro-organisms which was thought at first to be antagonistic, actually proved to be associative.

2. In a study of the decomposition of complex plant materials, such as alfalfa, by pure and mixed cultures of microbes, certain striking effects were obtained (Table I).[7] A fungus, *Trichoderma*, known to be an active cellulose-decomposing organism, did not attack the cellulose at all and the hemicelluloses to only a limited extent, but it decomposed the proteins quite rapidly, as shown by the amount of ammonia liberated. When a non-cellulose decomposing fungus, *Rhizopus*, was also present in the medium, *Trichoderma* attacked the cellulose and hemicelluloses; the same was true when other non-cellulose decomposing organisms were present, such as the fungus *Cunninghamella* and *Ps. fluorescens*. On the other hand, when *Trichoderma* was combined with an *Actinomyces*, there was considerable reduction in decomposition of both the organic mat-

[4] C. T. Butterfield, *Public Health Repts.*, 46: 393, 1931.

[5] E. J. Russell and H. B. Hutchinson, *Jour. Agr. Sci.*, 3: 111, 1909; 5: 152, 1913.

[6] S. A. Waksman and R. L. Starkey, *Soil Sci.*, 16: 137–157, 247–268, 343–357, 1923.

[7] S. A. Waksman and I. J. Hutchings, *Soil Sci.*, 43: 77, 1937.

TABLE I
DECOMPOSITION OF ALFALFA BY PURE AND MIXED CULTURES OF MICRO-ORGANISMS, THE LAST COLUMN IN MILLIGRAMS

Population	Total decomposed	Hemicellulose decomposed	Cellulose decomposed	NH_3–N produced
				mgm
Trichoderma	9.3%	4.7%	0.0%	61
Rhizopus	9.6 "	12.8 "	2.9 "	53
Trichoderma + *Rhizopus*	13.7 "	22.6 "	10.6 "	63
Trichoderma + *Cunninghamella* .	15.0 "	15.4 "	5.7 "	47
Trichoderma + *Bact. fluorescens*.	10.5 "	14.5 "	6.4 "	32
Actinomyces 3065 .	16.6 "	43.0 "	23.2 "	52
Trichoderma + *Actinomyces* 3065	12.5 "	14.6 "	4.8 "	56
Soil infusion	28.4 "	40.9 "	50.8 "	21

ter as a whole and of the cellulose and hemicelluloses. These results further emphasize the fact that two organisms may either supplement and stimulate one another or exert antagonistic effects. In the above experiment, the total soil population was far more active than any of the simple combinations of micro-organisms.

3. As early as 1877, Pasteur[8] noted that the development of anthrax in sensitive animals can be repressed by the simultaneous inoculation of *B. anthracis* and various other bacteria. Subsequently, there have been numerous instances of reduction in pathogenicity of an organism by the presence of other organisms. The most striking illustration of this is the recent work of Dubos,[9] who succeeded in isolating from the soil a spore-forming bacterium which produces a substance destructive to all Gram-positive organisms. By using the method of soil enrichment, a method quite common to the field of soil microbiology, since the early work of Beijerinck and Winogradsky, he enriched the soil with the specific antagonistic organism; the latter could then be isolated in pure culture and its specific physiology studied.

Numerous other instances of associative or antagonistic relationships of micro-organisms in nature can be cited. Among these, the most interesting relationships pertain to the behavior of pathogenic organisms brought in contact with a native population, such as that of soils, sewage, or water basins. Jordan and associates,[10] and others, noted many years ago that *Eberth. typhosa* can survive a much longer period of time in sterilized than in unsterilized water; the presence of specific bacteria, such as *Ps. fluorescens*, reduced the survival period of the pathogen. The presence of bacteriolytic substances in sewage and in sea water has actually been established. Studies on the behavior of *Mycob. tuberculosis* in soil brought out the fact that whereas these organisms can survive in partially sterilized soil for long periods of time, under a variety of conditions, they are slowly destroyed in fresh soil.[11]

The destruction of pathogenic organisms in soil is believed to be brought about in four different ways: (1) unfavorable environment; (2) lack of sufficient or proper food; (3) destruction by predacious agents; (4) development of certain soil microbes which check the survival of the pathogens through the formation of toxic substances. Other still unknown mechanisms may also be active.

One may well inquire, what is the nature of the struggle for existence among the microbes and how does it express itself?[12] The answer would be that one is dealing here with highly heterogeneous populations, comprising numerous diverse species, belonging to various plant and animal groups and possessing distinctly different physiological characteristics. Some provide food for others,

[8] L. Pasteur, *Compt. Rend. Acad. Sci.*, 85: 101–105, 1877.

[9] R. J. Dubos, *Jour. Exp. Med.*, 70: 1, 11, 249, 1939.

[10] E. O. Jordan, H. L. Russell and F. R. Zeit, *Jour. Inf. Dis.*, 1: 640, 1904.

[11] C. Rhines, *Jour. Bact.*, 29: 299, 1935.

[12] G. F. Gause, "The Struggle for Existence." Williams and Wilkins Company, Baltimore, Md. 1934.

some assist others, some compete with others and some actually prey upon others or destroy them by means of other mechanisms. This expresses itself in the appearance of a balanced soil population, susceptible to change with alterations in the medium, in which the dominant types are those organisms which are well adapted to the environment.

Human and animal excreta and other animal wastes as well as plant residues, which are frequently both offensive and endanger health, find their way into the soil. Fortunately, they do not accumulate in the soil, which would have rendered it an unsightly, disagreeable and unpleasant body, which man would not dare to tread. On the contrary, the soil has assimilated all these plant and animal wastes, and has completely destroyed their undesirable characteristics. Through the ages, the waste materials of plant and animal life have disappeared, whereas the soil has remained essentially the same. The capacity of the soil to destroy and absorb these wastes is dependent upon the micro-organisms that inhabit it. Among these, the heterotrophic bacteria, the fungi, the actinomycetes and also the Protozoa are the active agents responsible for these purification processes.

The important ultimate products of destruction of the organic residues are ammonia, carbon dioxide, water and various mineral substances, such as phosphates, sulfates, potassium salts, etc. These are essential for the continuous growth of higher plants. All Chlorophyl-bearing plants synthesize carbon compounds from carbon dioxide and water. If heterotrophic organisms had not liberated the carbon dioxide in nature, all the atmospheric carbon would have become rapidly accumulated in the plant and animal bodies. All plant life would have ceased until devastating fires again liberated the carbon as carbon dioxide. If the carbon cycle, as well as the cycle of nitrogen and of various nutrient minerals were incomplete, the continued growth of vegetation, which is also the basis of all animal life, would not have been possible.

These facts are now well recognized and utilized. However, the ability of the soil microbial population to combat organisms causing plant and animal diseases is only now receiving some of its due consideration. One can only guess as to what may be revealed in the attempt to combat the dangerous microbes which lurk in wait of an opportunity to attack domesticated plants and animals, as well as man himself.

There is increasing appreciation of the probability that nature harbors many unknown organisms, and that we still have quite incomplete knowledge of the activities, potentialities and importance of many well-known microbes. We are at the beginning of a period of domestication of a new type of organism, which may help in combating the deadly enemies of man. Micro-organisms represent in this respect a totally different branch of biology in relation to human welfare. It is said that, since history began, man has brought about the domestication of very few plants and animals that were unknown and not utilized by primitive men. The micro-organisms represent in this respect a unique exception. Although man, in his struggle for existence, has domesticated and learned to utilize the activities of many microbes, notably the lactic acid bacteria, the wine fermenting, beer fermenting and bread fermenting yeasts, these represent only a small fraction of those micro-organisms which have become domesticated with recent years. It is sufficient to mention such organisms as citric acid producing, butyl alcohol and acetone fermenting, legume bacteria, and others concerned in industrial fermentations and in agriculture. We are finally approaching a new field of domestication of micro-organisms for combating the microbial enemies of man and of his domesticated plants and animals. Surely, microbiology is entering a new phase of development.

IS THERE A PHYSICAL BASIS FOR RACE SUPERIORITY?

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ANY discussion of racial or biological superiority must rest on the basic assumption that differences exist between types of life, between divisions within any particular type and between members of the same division. Common sense and a little observation tell us that all these are true. We do not need a scientist to prove this by exact measurement and description. But the questions as to the magnitude of the differences and the fundamental character of the traits under consideration must be answered. In most popular discussions of race differences the assumption is made that superiority is a general trait in itself. This is far from the truth. There are several possible ways of proving racial superiority if it exists. The first of these is to make a catalogue of all the traits of man (Davenport has listed in "The Trait Book" a thousand or more of these), subject various representatives of different racial groups to carefully controlled experiment, and then balance the account to see where the majority of superior standings are. That is, the racial group showing a significant difference in, say, 51 out of 100 traits might be said to be superior.

A subsidiary method for proving racial superiority is to select a trait or a group of traits and make the determinations on this basis alone. This does not prove anything except that one race is superior to another in one particular feature or in a few specialized characters. In the end we would have no substantiation for statements as to relative superiority or inferiority. Actually this is what is done in popular discussions.

The third method, which is the most common and which has no scientific validation whatever, is to take the obvious differences on the physical side, such as eye color, skin color or a resemblance to a more primitive type, and erect on these data an evolutionary structure, assuming (to give an extreme example) that the more one resembles an ape physically the more ape-like are the mental and social capabilities.

One of the essential traits of man is that he is endlessly involved in sorting, classifying and cataloguing. The statistician is merely the n^{th} degree of the innate orderliness of the human mind. It is the tendency to classify that has led to this whole business of race classification and race evaluation. We are all collectors of one sort or another: be it stamps, coins, swords, books or knowledge. The quarrel is not with classification in and of itself but with the use of classificatory data when the person utilizing the material has nothing more in mind than the erection of a physical or social scheme of development. Much worse is the use of categories of incidental or non-functioning traits in building a philosophic hierarchy to explain the dynamic social forces which have been engaging our attention in late years. We shall hereafter focus our attention on anthropology and its classifications to learn in what ways the artificial groupings of mankind are different.

Much has been made of "survival value" in nature as evidence of varying degrees of innate superiority. Obviously, there are certain characteristics which serve to make some animals, in their own environment, reign supreme. If the pre-

sumed superiorities be analyzed they will fall into two major categories: structural and functional superiority. As examples of the former we may list such varying forms as the skunk with its scent mechanism, the porcupine with its quills, the ant-eater with its sickle-claws and its thickened coat, the rhinoceros with its horn and armored hide and the lion with its claws and fangs. In these forms there are morphological structures specialized for defense and attack. For our examples of functional specialization we may note the squirrel, blue finch and ant; here superiority is measured in terms of ability to provide for the young, to build nests, and the aptitude for social cooperation.

From these examples it is evident that superiority is not a single unit character, but that there are superiorities which, depending on the method of classification, might be reversed. And all "natural" superiority bows its head when confronted by a little lead pellet propelled by a steel tube with a superior "thinking machine" at one end of it—Colonel Colt was right when he referred to his invention as an "equalizer"!

It will be noted that in the foregoing classifications of natural superiorities or, better, specializations, we are dealing with differences which are intrinsically important and which bear out in general the theme that indices of superiority must be considered only when they check absolutely with performance. The fact that the leopard has a spotted coat and the zebra a striped coat, that one animal has curly hair and one has none, that even size within certain limits is incidental, must form the basis of further discussion. That is, superiority must be measured in something which is really important in a functional way. This point must be kept in mind as we consider qualitative and quantitative differences in man.

What of this superior "thinking machine"—man? How may he claim to be physically superior? His body is a veritable museum of vestigial remains; according to the biologists the human body has at least 100 useless structural elements, though formerly in man's evolutionary past they were of great service. Man! Biologically immature until 14 to 15 years; until then he can not reproduce his kind. Legally immature until 18 to 21 years: until then he has no real voice in his destiny. Socially, economically immature until 25 years or even later: not until then can he successfully become head of a family. In terms of rapidity of development most animals are superior to man; so also in acquisition of food, running speed and a host of other traits. Wherein, then, lies man's vaunted supremacy?

Man is distinguished from all other animals by the relative size and the elaboration of his cerebral cortex. There are, to be sure, animals with absolutely larger brains, as, for example, whales and elephants. The brain of a whale may weigh as much as 7,000 grams. We may demonstrate man's brain-mass superiority by noting several brain-weights at random: Lion 200–250 grams; horse, 600–800 grams; chimpanzee, 375–400 grams; gorilla, 400–500 grams; man, 1,400–1,500 grams, with an extreme weight of about 2,200 grams. If these brain-weights are calculated in terms of relation to body weight, then significance is obvious: Man, 45:1; chimpanzee, 192:1; gorilla, 200:1; lion, 490:1; horse, 746,1; whale, 10,571:1.

These body-weight: brain-weight ratios emphasize the fact that it is not in mere mass of brain that man is superior. The characteristic in which man is presumably superior to the animals is found in terms of the quality of his mental reactions, *i.e.*, functional response in those aspects of life in which superiority comes because of a greater adaptability to the environment, involving reasoning, insight and creativeness.

By reason of man's achievements we can

safely assume that in comparison to other animals he is superior because of the greater substitution of thought and reasoning for hasty inconsidered action. On this basis the hypothesis that superiority can be measured in terms of higher ranking in a majority of traits can not be substantiated. We have just seen that man's superiority is due to a constellation of traits having to do principally with the higher mental processes. Can we apply this to differences between races of man or must we return to an evaluation of multiple traits as a criterion?

It is time now that we define the term "race." Frankly, it is very difficult to do. In general, a *race* is a group united by blood and heredity; there is implied a continuity of the blood-stream and of the germ-plasm. In this sense race is identical with the general biological concept of a "breed." When we speak of *racial* characteristics, therefore, we refer to certain physical traits that are, within each group, predetermined by heredity and in which all members of the group participate.

It must be quite obvious that there are marked degrees of clarity in the elucidation of the hereditary pattern. For example, it is simple to segregate in the Nordic the blue eye, the fair skin, the blond hair; and in the Negro the brown eye, dark skin and black, kinky hair. But if one were asked to distinguish the brain of a Nordic and a Negro criteria of differentiation would be either lacking or so slightly developed as to defy classification in any given instance.

Just as hereditable differences are variable in their distinctness, so races themselves are extremely variable with respect to their constituent elements. By this I mean that degree of homogeneity varies. It is almost certain that no race or group to-day is 100 per cent. pure. Speaking in hereditary terms, what we call nowadays a *race* of man consists of groups of individuals in which descent from common ancestors can not be proved. In other words our basic definition falls in the presence of intermixture.

An examination of the physical characters by which races are differentiated discloses the fact that the principal categories are skin-color, hair-color and texture, and shape and size of the entire body and its component parts.

An Egyptain tomb at Thebes contains a series of paintings on the walls depicting four different types of mankind. That they are different we know by the color of the skin: Rudu, the Egyptian, is light red-brown; Nasi, the Negro, is black; Amu, the Semitic Asiatic, is orange-yellow; Tamehu, the North African, is white. To this day we classify races on the basis of skin color and recognize three main types: White (Caucasoid), Yellow (Mongoloid) and Black (Negroid). The Europeans still call the aborigines of America Red Indians to distinguish them from the East Indians. *Skin color* is a very obvious method of classifying races.

Closely paralleling skin color is *hair color*, hair texture and hair shape. Skin and hair color are virtually parallel phenomena, *i.e.*, light skin and light hair, black skin and black hair, tend to go together, though this relationship is not absolute. *Hair texture* may be classified as follows: straight, wavy, curly, tightly curled, and woolly, kinky or frizzly. Roughly speaking, the Mongoloids have straight hair, the Caucasoids wavy to curly, and the Negroids tightly curled to frizzly. *Hair shape* is classified much the same as the foregoing: straight hair tends to be round in microscopic cross-section, curly hair ovoid and woolly hair a flattened or kidney-shaped oval. The classification of hair shape is so extremely variable, however, that its import is greatly lessened.

The most wide-spread method of race classification—because it can be used for the living as well as for the dead—is the

famed *cephalic index*, which measures the ratio of head length to head breadth in the index $\frac{\text{Breadth} \times 100}{\text{Length}}$.

The index is classified as dolichocephalic or long-headed, if it is below 75; mesocephalic or middle-headed, if it is from 75 to 80; and brachycephalic or round-headed, if it is above 80. In general Negroes and North and South Europeans are long-headed; Anglo-Saxons, Polynesians and some Japanese and Chinese are middle-headed; Asiatic Mongoloids and mid-Europeans are round-headed.

The foregoing: skin, hair, head, are the principal methods of race classification. We might also linger over stature, nose form, facial proportions, cranial capacity, but we should only belabor our point: that the peoples of the earth do fall into more or less naturally defined physical types.

One of the first questions that comes to our minds is how long this physical differentiation has been going on. The answer must be given in terms of thousands of years. Physical (racial) homogeneity is not one of man's achievements. The Old Stone Age is written in terms of the Neanderthal, the Cro-Magnon and the Grimaldi races—the last named a Negroid type. Of interest to the anthropologist is the fact that all were long-headed. At the close of the Old Stone Age there appear, fully evolved, round-headed types at three widely separated points in Europe: Furfooze, in Belgium; Grenelle, in France; Ofnet, in Moravia. Racial differentiation and racial intermixture have age-old histories. The pace of the former has been retarded, of the latter accelerated, by the tremendous development of world-wide contact. In the face of this, "race purity" becomes but a shibboleth, for isolation is the guarantor, contact the destroyer, of racial homogeneity.

At this point we must inquire as to the origin of race types. Was man cast in one mold or several? If the former, which of the present day groups was basic; if the latter, what was the cause of the initial differentiation? These questions can be answered only in part. We run the gamut of theory from special unique creation to the polyphyletic theory of Crookshank, who would derive the Negroid from the gorilla, the Mongoloid from the orang and the Caucasoid from the chimpanzee (the last thought to be the most intelligent of the Anthropoids!).

The evolution of animal forms is written in terms of two factors: isolation and its corollary, inbreeding. The establishment and perpetuation of animal types are accomplished almost solely by segregation and its resultant lack of contact. These factors are certainly non-operative in the evolution of present-day human physical types. Man to-day recognizes no physical bounds, and if we read the record of the past aright he has rarely been baffled by geographical barriers (with the sole exception of the great oceans). We can, therefore, explain intermediate physical types as hybrids, resulting from race mixture. But how may we explain our basic types?

In recent years research has shown that the normal growth of the body is the result of the correct balance of the endocrine glands. This growth-regulating mechanism has been invoked by Bolk, Keith and others as the guiding force in the evolution of human physical types. To state their conclusions succinctly, in the Negroid the pituitary is slightly in the ascendancy, in the Mongoloid the thyroid exerts a slightly greater influence, and in the Caucasoid there is a state of balance which is rather inhibitive in its effect, so that the apparent hyperendocrinism of the Mongoloid and Negroid is suppressed.

Here, then, we have a possible means by which the major types may have been

evolved. In our present state of knowledge the theory is to be recommended more for its ingenuity than for its actuality, yet it seems to be a step in the right direction.

Regardless of origin or cause the *fact* of racial differentiation has given rise to speculation concerning the *import* of racial differentiation. Are these differences the reflection of the retention of a primitive pattern, the modification of a basic type or the specialization of specific characters? In other words: do the races of man precipitate themselves into retarded groups on the one hand and advanced groups on the other; are there inferior and superior races?

There are, I think, two main approaches to this problem: the anatomical and the cultural. Let us consider the first.

Usually the assertion of physical differences is limited in this country to a contrast between the White and the Negro. It has, until comparatively recently, been part of the general cultural pattern to regard the Negro—or for that matter any non-White people—as an inferior race fit only to be subjugated; for the obvious differences in skin color, facial development, etc., early resulted in a comparison of "lower races" with the Anthropoids, a procedure which leads to the conclusion that the Negro had not evolved so highly as the White. The prognathism, the lower forehead, the dark skin, the wide nose, all seemed primitive characters. Modern research has now observed that the tightly curled or kinky hair of the Negro, his smooth, hairless skin, his thick lips, are specialized characters, in which the White is the more primitive. The theme needs no further elucidation: if the "specialized" and "primitive" bodily characters in each race—White and Black—be tabulated, it will be found that the credits and debits, so to speak, balance one another.

In 1856 Gratiolet stated that in the Negro "the cranium closes itself on the brain like a prison. It is no longer a temple divine, to use the expression of Malpighi, but a sort of helmet for resisting blows." Such a flight of poetic fancy implied that in the Negro the cranial sutures united very early, thereby rendering impossible the acquisition of further ideas, imaginations or knowledge; in short, denying any further progress toward civilization. The work of Todd has given the lie to this statement, for not only is the Negro's suture-closure pattern identical to that of the White, but step by step the Negro parallels the White in his anatomical development. The differences observable between the two are of the same degree, or less, than the differences observed in Whites of diverse socio-economic levels.

What shall we say of the brain within this cranium? Shall we follow Bean, of Virginia, who states that the cerebral pattern of the Negro forebrain is inferior to that of the White; or shall we accept Mall, who reports (on the *same* material) that interracial and intraracial variability is so great that it is impossible in a given instance to state the racial origin of a brain? It seems to me that the whole problem of the normal human brain narrows down to this issue: not so much what is there but how it is used.

About the sole criterion of general physical inferiority or superiority applied to all modern races is the question of disease susceptibility and immunity. This problem has been aptly summarized by Hrdlička, whose data may be tabulated as in Table I:

This is an interesting list, but it is not to be measured in terms of inferiority and superiority—nor did the author intend it to be. It would be absurd to do so, for then each group would in and of itself present a conflict of "superior" immunities and "inferior" susceptibilities. We must go much deeper than this. The true solution will be found in problems of

TABLE 1

RACE	SUSCEPTIBILITY	IMMUNITY
North Europe	Whooping cough (except Iceland)	Goiter Cretinism
Alpine region	Goiter Cretinism	Pulmonary diseases
Jews	Diabetes Cancer Nervous disorders	Tuberculosis
Negro	Tuberculosis Diseases of heart, lungs, kidneys Influenza	Malaria Yellow fever Measles Scarlet fever Diphtheria
Full-blood	Smallpox	Rickets
American Indian	Measles Tuberculosis Influenza	Cretinism Cancer Diphtheria Typhoid Mental diseases (except epilepsy)
Eskimo	Smallpox Measles Tuberculosis Influenza	Dental caries (until recently) Skin diseases Typhoid fever

isolation and exposure, and most certainly in considerations of socio-economic standards.

I think enough has been said on the problem of physical differentiation. It is an observable quantitative fact. It is not qualitative in the sense of the evaluation of "high" and "low" characters.

But what can we do in the face of statements like the following:

> The mixture of two races in the long run gives us a race reverting to the more ancient, generalized, or lower race. The cross between a White man and an Indian is an Indian; the cross between a White man and a Negro is a Negro; the cross between a White man and a Hindu is a Hindu. . . .

As a matter of fact, we can't do a thing! We can, however, turn to the very sensible observation of Todd when he discusses the placing of Senegalese troops in the Rhine region after the Armistice:

> So far as prejudice against colored people rests merely on color it is absurd and mischievous, but where the difference in color goes along with a complete difference in level of civilization, as was of course true of the Senegalese who formed part of this garrison, it is the difference in civilization that matters.

With this we come to the problem of superiority and inferiority in cultural attainments.

To my mind the whole question of cultural inferiority or superiority rests upon two very naive assumptions: first, that if the civilization is high, the aptitude for social development is correspondingly high; secondly, that a race is the lower in the scale the more it differs from the White civilization, which quite illogically is used as a basis for comparison. There is an utter disregard of the primary factors in the development of a civilization: time, events and contact. The three great historic centers of cultural evolution—of environmental pressures—were foci of racial movements: the Yangste Kiang, the Euphrates, the Mexican plateau. Here were born the civilizations that gave us the Oriental philosophies, the achievements of a Sumer or a Babylon and the awe-inspiring grandeur of the Mayan cosmology. Who may say which is superior to the other!

Very closely linked to the problem of social development, and also virtually a corollary of the problem of physical characters, is the problem of the mind—of mental ability. I think we shall accept the statement made earlier, that there is no real difference in brain structure among races, even though size of brain may vary from the Bushman average of 1,200 grams, or less, to the Chinese average of 1,450 grams. What about the problem of turning capacity into ability?

Earlier students of primitive people were prone to attribute to them extraordinary acuity of vision and hearing, and they assumed a corresponding elaboration of the areas in the brain given over to these senses. This viewpoint has given way to the common-sense realization that the *training* of the primitive hunter has but emphasized in one direction traits shared equally by all normal

persons. All experiments performed to test the sensory faculties of the several human races are tests not so much of race as of the average experience and habits of groups of different culture.

This is but one phase of the problem. We must look at mental ability in terms of the "intelligence tests." Are there innate differences in mental behavior which will permit one group to forge ahead of another in the keen competition between civilizations?

The answer must be in the negative. One can not deny that there are levels of civilization. We ourselves have passed through an age of chipped stone, of polished stone, copper, bronze, iron and steel. It is not surprising that the passage of time has been unequal in its distribution of contacts permitting the exchange of ideas. Whatever we may say, however many aspersions we may cast, civilization is not parasitic. Its roots are sunk deep in the firm ground of history, and it has been nourished by events and personages—mostly linked up with war, for the progressive movements of peoples have ever been associated with strife.

The fact of cultural differentiation is therefore no criterion of the ability for the development of culture. We simply can not measure this ability by any arbitrary standard. Our tests must focus upon the attainment of the group, in their *own cultural setting,* and not measure group achievement in terms of an attained level in a recognizable series.

This discussion can not be closed without recognition of the problem of nationality, which may be defined as an artificial grouping around a language as an expression of tradition and aspirations.

At the moment nationalism is rampant. It is based for the most part upon a conscious prejudice which strives to recognize a "we-group" and a "you-group." According to Keith this is the expression of an age-old endogamy and exogamy; he would take it still further back to the attempt of nature to achieve the isolation necessary to the rise and perpetuation of a definite physical type. Prejudice becomes a political weapon and nationalism emerges. If the process be thorough and long-continued, says Keith, then a nationality may become a race.

I can say but little of nationalism except that it has no basis in physical or cultural superiority. It rests only upon an appeal to sentiment and is a conscious effort to achieve solidarity based upon a common background and a common aspiration. The theory is splendid: the practice far too often is provocative and misguided.

I repeat the question: Is there a basis for race superiority? My answer must be that there are observable and measurable quantitative racial differences both as to physical and cultural development; but there are no measurable physical or social qualities which are in any given group superior or inferior.

Knowledge is slow of foot and
Wisdom limps far behind knowledge.

FILIPINO VILLAGE REMINISCENCE

By Dr. ELSIE CLEWS PARSONS
NEW YORK CITY

JOSÉ ALMENDRALA left his Tagalog village ten years ago at the age of seventeen and has lived since then in California or New York, but his Filipino life is not forgotten. Each day as we talked his boyhood in San Pedro, a bayside village in Laguna Province, became more and more vivid to us both. He remembered how he got through the wire fence around the *convento* and rang the church bell while the sacristans were not looking. Everybody lived by that church bell, one bell for Mass at 6 A.M., three bells at 10 for the second breakfast, two bells at noon for dinner, four bells for the afternoon prayer, a "little bell" at 6 P.M. for supper, and then, an innovation by the "new priest," a bell at ten for bed. Rice and fish made the meal, fruit also except at breakfast. Nobody would think of eating fruit in the morning, for it gave you a pain or gas, laughed José, thinking of American orange juice at breakfast. And he laughed over playing robbers the night of All Souls or of standing in the water-buffalo cart in the plaza Christmas afternoon when the child first to make himself shed tears or to let a coin slide down his face into his mouth would get the penny or a prize. He described the blowgun he used for shooting birds (what Spanish sailor or friar imported the blowgun from America?) or the cage without a bottom concealed over a nest and pulled down by a string when the bird sat on her nest, and as skilfully as ever he could make a bamboo and paper kite, with banana peel and a flower for the tail. He sang the planting song he had heard so often as he flew his kite near the rice fields lying between his house in the Centre and the shore.

> Rice planting is not all fun.
> Bending down all day
> I may not even sit down
> I may not even stand upright.

As the barefoot women in their Chinese bamboo hats sing and plant, men play their guitar-like *banduria* or beat their drum of carabao hide on the edges of the field. It is a village work-party, with a measure of last season's rice as pay and, of course, a noontime dinner in the fields. There are other work-parties for reaping or harvesting, for threshing or winnowing. Girls will winnow of an afternoon, tossing the rice from a basket and, if need be, whistling, like a sailor, for a breeze; everybody takes part in threshing, flailing the rice on a nipa mat to song and guitar, a night party, a time for courting.

In a population of about 800 only five or six men (the rich men, *mayaman*) own rice fields or sugar plantations, and these bring in one tenth of the harvests, the tithes, to the "Hacendero," just as they formerly paid them to the Jesuit monastery the Hacendero now occupies. San Pedro villagers are poor to-day because the "Castilas," the Spaniards, more particularly the "Huswidas," the Jesuits, appropriated the land, but why any tax is paid to-day on hereditary family lands José did not know or question. It is probably a survival of the barangay "tribute payer" organization (a barangay was composed of several "tribute payers" or family heads, controlled in turn by the head of the barangay).[1] In San Pedro tradition,

[1] J. R. Quirolgico. Ms., University of Nebraska, 1928–29. According to de Morga (1609) the barangay was a territorial unit. When the lord or possessor of a barangay gathered in his rice those that were of the barangay

under Spanish rule all forms of property were taxed or levied upon. To make him confess the number of his carabao,[2] José's grandfather was once subjected to the "water cure" (*tinutubig*,† ordeal water), the ingenuity used by the Spaniards and borrowed by American officers and applied not only in Luzon, they say, but in northern Mexico, in preference to the Conquistador way of toasting the feet. "Water plugging" in San Pedro, if not elsewhere, led to false accusations, for when a man was tied down in the plaza and the pipe run into his mouth he might charge any bystander with anything to escape the torture.

To-day house lots around the plaza, *i.e.*, in the Centre or in the six barrios, the outlying settlements, are levied upon by the "tail of the hacienda" or *escribiente*,[3] the tax collector of the hacienda, who will "cut the house posts," *tengaka*, of any one failing to pay. The tax collector, said José, was always drunk, and people would apply one of their numerous proverbs: "In spite of many legs [like the centipede] he too may fall."

House piles are cut pacifically when a house is to be moved. José recalled the moving of the family house in the waterside barrio of San Roque to a site bought by his father in the Centre. Cut free from its seven-foot piles and divested of its nipa mat walls, the thatched bamboo house was transported on men's shoulders during the noon hour when neighbors were idle, and then all the bearers, twenty or so, were regaled with cigars and fresh palm wine. To the little boys of the family it was a thrilling feat; to the adults it meant a move upward in society, from a "dying barrio" of country people to a centre of civilized interests, to the neighborhood of municipal building, of the church of the town's patron saint, of curacy or *convento*, schoolhouse, barber, stores and major market: to the Spanish plaza. And near the American railway station. The railway came through in 1910, making of San Pedro a potential suburb of the city of Santa Cruz and bringing it within three hours travel of Manila.

But as yet San Pedro remains an independent town or village with its own Centre and its own wards, its barrios. Each barrio, excepting Loúban, has its own little market, its chapel and its own patron saint. Loúban, garden or "backyard," is a sugar-cane plantation and people have only an occupational or seasonal residence there. Still they may refer to San Isiro (Isidro), the farmer's saint, as their patron. Landayang, the largest barrio, where about half the population live, San Roque and Kuyab are fishing settlements. At Landayang a woodcutter found the miraculous image of Jesucristo, who cures pilgrims bathing in his pool at his festival the end of May. The image is carried around the pool in a procession by night, and after this procession it always rains—"the miracle of Nazaret." Pilgrims who kiss the feet of the image believe that oil issues from them. ("Perhaps an altar boy has rubbed it on" was José's sceptical aside.) Pilgrims come from great distances. The image of another barrio, San Vincente, is miraculous against fire, having once checked a fire in its barrio. Kuyab's patron is Santa Ana; her festival is June 15. At San Roque's September festival his image is carried in a freight barge, with two men flourishing bolos in the bow to drive out the "devils," and there is a mock battle called *pagoda* between outrigger canoes trying to sink each other by paddle—

and under his "governance" went for a day to assist him, likewise if he built or repaired his house. "This chief, lord of a barangay, collects tributes from his followers and takes them under his charge to pay them to the [Spanish] tax collectors" (The Philippine Islands, 322, Hakluyt society, 1868).

[2] A rich man would have from fifteen to thirty; a poor man from two to five.

[3] Here as throughout I write the Spanish word as it is Tagalogized.

obviously an amiable acceptance by the saint of some pagan practice.

The barrio of San Antonio has been invaded by Protestantism, introduced by somebody from Malubon, a town in the adjacent Province of Rizal. San Antonio Protestants are strait-laced, foregoing smoking and drinking and cockfighting, and the people of this barrio are contesting the prerogatives of Dong Balencia (Don Valencio) their hacendero neighbor, also the toll imposed by the town on the wood San Antonio men bring in to market. There is no toll on produce from the other barrios, on fish, they argue. Betel nut trees are grown in San Antonio. Betel nut trees, by the way, are always owned apart from the land. Betel chewing, a woman's habit, said to prevent toothache, has not been given up by the Protestant women of San Antonio. Among these anti-Catholics there is said to be much cousin marriage. I would like to know more about these Filipino Puritans.

Between barrios there is normally a certain degree of rivalry or jealousy, traditional at least at the celebration of the town fiesta (*fista nang baian*) on May 1 and 2, when each barrio marches separately behind its brass band. In this *paséo* double quick, *paso doblé*, and in the plaza the bands try to outplay one another, and instruments may become weapons. Also if you go acourting by night in another barrio, as you are returning home the barrio "boys" may waylay you with bolos. At least one barrio is nicknamed derisively as fish eaters—*mangingisda*. Such attitudes are to be found in Mexican barrios and so are peculiarly interesting to students of Spanish America who are puzzled about the history of the barrio, whether it is wholly Spanish or partly Indian.[4] To any student of acculturation the barrio-Centre distributions of San Pedro would be interesting: Spanish culture concentrated in the Centre, native traits surviving in the barrios, where, for example, a man is not shaved at all but plucks his face with bamboo tweezers or where any afternoon women may be seen sitting in a row one behind the other delousing the head of the one in front, a delousing party, *kutuhang*. Other archaic barrio ways will come out as we continue our survey.

Perhaps the barrio of Landayang was the original settlement. For one thing not Saint Peter but Jesucristo of Landayang is the personage honored at the fiesta of the town, honored by Mass, procession and dance-drama, by greased pole, the "horses" (merry-go-round), cockfight and gambling, by fair, by blind or selfmaimed beggars and their blessings, and by feasting. You eat many dinners of roast pig; all your relatives invite you to their houses. José was twelve years old the first time he tried the thirty-foot pole from which waved a flag, and to which hung a bag of money, three pesos contributed by the rich. José used a hempen rope as sling around his ankles and the pole; and his uncle threw him some sand to rub on his legs.

The dance-drama, performed on a platform, is Moromoros, a version of the performance of Los Moros that was carried around the world by Spanish friars or colonists the better to celebrate their saints.[5] The Moors are in red, the Cristanos in blue. The Christian king or captain referred to as Mirabal sits between the two lines of soldiers and Moors; he wears a crown of bamboo and flowers, and the Moro girl or sultana called Manerba falls in love with him.[6]

[4] E. C. Parsons, "Mitla," 500–501. Publications in Anthropology, University of Chicago, 1936.

[5] Many dancers and musicians "represent dramas and plays in Spanish and in their own language very gracefully . . . due to the care and assiduity of the monks" (de Morga, 320).

[6] Compare Malinche in the Matachina dance of the Pueblo Indians and of northern Mexico, and the two little girls, one for Montezuma and one for Cortez, in La Conquista of Oaxaca.

The Moro king is threatening and insulting. Sword play, dance steps and dialogue which has been taught from a text by the *maestro.*[7] *"Embajador,"* princess, queen and her ladies (*damas*), who are three beautiful girls, and, of great interest to Americanists, a clown, *comidiante,* who dresses in red, wears an odd palm leaf hat and has his face painted white and red "so as not to be recognized," who imitates the others, tailing on to the line of Moors, picks up a bolo, smokes a cigar, gestures to the children, climbs posts, snoops up behind lovers and improvises jokes: all just like the behavior of Spanish-Indian clowns.[8]

In conclusion *pandango* (Sp., *fandango*) is danced, girls in one line, men in the other, to the guitar. Then the dancers sit down on the ground and are served palm wine and a meal off banana leaves. Still later the play of what Spanish Mexicans call *las piñatas*[9] is in order. A pottery jar filled with water or fruit or cakes is hung up, and the blindfolded hit at it with a stick.

This celebration has displaced that of Holy Cross, usually celebrated on May 3 but held in San Pedro on May 15. On the preceding nights of May the Cross has been carried in procession by young people who beg with a tin can, and each night the Cross is carried to a different house and kept there and the company entertained at supper. The last night a bamboo bower is built in the plaza. There is a dramatization of some kind: a queen guarded by soldiers is sentenced to death—that is all José remembered. In the afternoon a pole and ring game is played: boys spear rings hanging from ribbons given by the girls, the boys on bicycles instead of horses, the last direct word of the medieval tournament.[10] The girl's name is on the ribbon and she redeems it by a present to the boy.

Of Holy Week celebration, always in Catholic circles the ceremonial peak of the year, Palm Sunday is particularly well observed, at least according to the recollections of a boy. From four platforms, one on each side of the plaza, girls sing and children throw flowers on the procession with the saints. Palms are planted in the plaza, and as usual palm leaves are plaited into various shapes (but these are not charms against lightning, as among Spaniards, nor used in curing;[11] they are hung behind the house altar). For a certain period in Lent young men have gone about at night to read and pray in houses which contain the Cross or images of San Pedro or Jesucristo: a practice Dr. Beals has found highly formalized among the Catholicized Mayo-Yaqui Indians. During Holy Week women give up chewing betel. It is sinful to eat meat. No work is done. *People stay quiet; it is a dangerous time.* When the lights are put out in the Thursday evening service (*tenebias,* Sp., *las tinieblas*), it is said that "the world is collapsing."[12] *Penitentes* whip themselves with a leather metal-tipped thong, drawing blood, or they cut themselves with broken bottles. (Franciscans, the Third Order, as well as Jesuits must have entered the Islands.) In the Friday procession impersonations of the Apostles pull the cart containing Cristo in his coffin. Men fence with bolos, and sometimes get cut. For four days until the Gloria (Saturday morning, the ascent to Glory) the *matraca,* the wooden rattle, is used; they say Judas has stolen the bell. When the bell rings out, children

[7] Every barrio has its own dance master and dance company, who will be paid on visiting another barrio. Making a *promesa* or vow to dance, as in Mexico, is unfamiliar. Moromoros will be danced on barrio saint days and again at the general celebration of Kings' Day, January 6.

[8] E. C. Parsons and R. L. Beals, *American Anthropologist,* 36: 491–514, 1934.

[9] Compare "Mitla," 249.

[10] Compare "Mitla," 69; and the New Mexican or Yucateco or Guatemalan chicken pull.

[11] Compare "Mitla," 266, 510.

[12] Compare "Mitla," 268–269.

jump into the air to grow faster, and people shake their fruit trees to make them grow.[13]

We referred to the boys playing robbers on All Souls, which day or night in fact is called Lundras (Sp. *ladrones*, robbers). In the afternoon while families are visiting the cemetery or praying indoors and eating cakes the boys make of baked clay some sort of figure called *kalán* in the yard or garden and later in little gangs go around stealing chickens or turkeys or fruit. They know that if caught they would be beaten with bamboo or even slashed with a bolo, "but they are never caught." Sometimes they disguise themselves. They plan the raid days in advance and select their scouts (Sp. *espía*). One year José was the scout and diverted the attention of his Aunt Goria (Gregoria) of the barrio of San Roque while his gang were in her yard stealing a big *lanka*, a fruit much prized and well looked after. The tree indeed is sacred. When it exudes gum, people say, "God is asserting himself."

Christmas, Pasco (Sp., *Pascua*) is for José another memorable celebration. For the midnight Mass referred to not as elsewhere as *misa de gallo*, mass of the cock, but as *disperas nang pasko* (*vísperas de pascua*), the plaza is set all around with bamboo torches—the Christmas fires.[14] Young people walk and talk in the shadows, another chance for courting. Christmas morning José went with the other children of the family and his cousins from house to house, to uncles and aunts or godparents who gave them *aguinaldo, i.e.*, money or cocoanuts and, as they knelt and kissed the hand, a blessing. "*Tabe tabe nang poong* (or *Dios*), May God bless you!" José's little band always visited the store of the "uncle," who was the richest man in town and a former president. Finally the band of children would visit the *convento* and the priest would lead them to the church and sprinkle them with holy water. There was a family feast of roast pig stuffed with banana leaves, of special cakes of rice or bamboo, and a "ginger" drink, *salabat*. At this feast (*handa*) or any other, chicken entrails are inflated and hung on the house wall for "good luck."

On New Year's eve (Sp., *año nuevo*, T., *bagon t'aon*) paper lanterns are carried round. The band plays. In the plaza cakes are sold and bamboo "cannons" are exploded.

The general governmental set-up of San Pedro is, like the church calendar, much the same as that established by Spaniards in America: a council with presiding officer or *presidente* (*panǵulo*). The president is chosen every few years in general assemblage, by written ballot, through informal nomination by the councilors and inferably without dispute since the barrio voters are called derisively *kantatango*, "yes men." "They don't know what it is all about." Perhaps; for here speaks the sophisticated man of the Centre, who ridicules the accent or fish diet as well as the "ignorance" of his country cousins. Each barrio has a councilor or *teniente* (lieutenant), an executive who serves without pay indefinitely, "until people get tired of him." Every Sunday he is entertained at supper, house by house, and when he leaves everybody spins his plate around (clockwise, the circuit always favored by José) that no mishap befall the guest on his way, a customary conclusion to hospitality.

To-day, if not formerly, the president is paid in money. Paid also are a secretary, a treasurer, a postmaster and two policing officers (sergeant and corporal). Highway robbery or stealing carabao or rice seem to be the major offences. A judge, with authority superior to the president's, is sent from the capital of

[13] Compare "Mitla," 276.

[14] *Las Posadas*, the nine-day house-to-house visiting before Christmas, is unfamiliar.

the province. This judgeship, also the practice of paying municipal officers, are probably modernizations.[15] Of an earlier period is not only the unpaid barrio officer but the town crier, who holds office for life. He is appointed by the president to announce his orders, announcing generally in the evening, about nine o'clock, from barrio to barrio, perhaps droning out "nothing more important" than "the president directs you not to let your roosters run about."

The early Spanish terms, *alcalde* (judicial and military officer) and *principales* (former officers) are unfamiliar, although the president was formerly called *capitán*, and an ex-president is still so called. The town Socrates, José called his ex-presidential "uncle," as he tried for an American paraphrase. Local government has been changing, I believe, and terms and functions have been confused, at least in the mind of one who left town before he became a voter. Even so it was surprising to find that the Spanish cane of office was unfamiliar to José.

José's knowledge of life in the family is comparatively clear and full, even to details an American boy might ignore. While José's mother was pregnant that old-world evil-spirit prophylactic garlic, was hung around the walls of the house and at night his father kept his bolo close at hand, against the *asuwán*, a winged being peculiarly dangerous to pregnant women since he can steal the fetus. Once José overheard his mother telling some women of just such a case. A big pig was seen at the time rooting under the house. An *asuwán* can transform into a pig, a goat, a carabao, a snake or a man. He can steal your liver; he steals the liver of a corpse. Children are told not to go out in the dark lest they hear the sound of wings and the *asuwán* get them. "You will disappear." A wet cloth on the roof or wood ashes under the house as well as garlic inside will scare away the *asuwán;* but it is safest in pregnancy for a woman not to be left alone. As the Tagalog-American proverb goes: In union is strength.

Oddity or deformity will be set down to a prenatal cause. During one of her many pregnancies José's mother ate something sour and that brother is still a "cranky" fellow. In another pregnancy Manuela touched the head of a pig and the child was born with a "hairy ring" on his forehead. Because Manuela looked at the sun or at a calendar pictured with saints one daughter was blond and blue-eyed, like the Virgin. Looking at fish or at the moon may cause deaf-mutism or other defect in offspring. A child born during solar or lunar eclipse ("it darkens") will be dark-skinned (but not, as among Spanish Indians, deformed). During a solar eclipse, by the way, the village diviner will gaze into the water jar (as noted in Spanish America) and predict trouble, such as war. The women would kneel in prayer, as José once saw them do, and ejaculate, "God is punishing us! Why is he punishing us!"

There are both male and female midwives (*mangaganak* or *mangahilot*). To hasten labor the belly is squeezed. For slow labor a hot tile is put on the belly and on top of the tile the "olive-like" *kalambabit*[16] fruit is left to smolder. A root tea is drunk during the seven-day confinement, and for several weeks rice water made from rice first cooked dry. José remembers seeing his mother before the baby was born shake ashes from a cigarette into her mouth and swallow them; she said it was good for the baby.

Babies are baptized in the usual Catholic way, although they are not given the name of the saint on whose day they are born, not to-day at least. There are no Tagalog personal names, although José

[15] Yet pay for personal services to Spanish officials, to the friars and for communal work—weekly assignments called the *polo*—was customary (de Morga, 329).

[16] A San Pedro riddle: What do you put in your mouth and then (with gesture) throw away? Ans. *Kalambabit.*

thought "Juan" was one, "a real Tagalog name." Many Spanish words are supposed to be Tagalog; and even a slight phonetic change makes a Spanish word appear to be Tagalog. When I happened to use the Mexicanism *cabajo* (Sp., *cavallo*) in referring to the merry-go-round José looked surprised and exclaimed, "How did you know that Tagalog word?"

Nicknames are usually in Tagalog. One smallpox victim is called María Bulutonga, María Pox. Another María is Maríanbasa, Wet María, because she was once seen to wet herself as she urinated in the plaza. (People relieve themselves there or anywhere.) When Pablo's mother was carrying him she hankered for water chestnuts (*apuled*) and ate them. Her son's mouth was formed like one (Cupid-bow, we would say) and he is nicknamed Pablito Apuled. Siriaco the doctor is called Akong (Siriaco Tagalogized) Pisknot (noseless, ? a syphilitic). Macaria, a girl who "does not know anything" (*tana*) and at eighteen is still unmarried, is called Caria Tana. Acadio, once *jefe* or police chief, is known as Cajon Tinala, Cajon Chin-in-the-air. Nicknames may become patronymics. Dahōt, grabbing, is one because the father of the family once grabbed for some money when he was gambling. Supót, uncircumcized, is another, because the family head (another doctor) is actually uncircumcized. Such stories may be etiological, of course, but they also imply that the Spanish patronymic was adopted later than the baptismal name. Many townsmen are still known only by their Christian name, in the early European mode.

Some curious nicknames were applied, by the way, to the American military: "Kalambabit" (see above) because it sounds like much used Americano, "son of a bitch"; "labanus," a white plant; "*Americano* one two three *napote'e*," American one two three dung (on the march the soldiers stank). *Bangos*, a white fish, was applied to Spaniards. Pampamgeño people, from whom were Aguinaldo's soldiers and betrayers, are nicknamed *dugonaso*, blood dog. The unbeloved Hacendero of San Pedro is a Pampamgeño, and he is the butt not merely of nicknamers but of satirical singers. Indeed Dong Balencia must be constantly biting his tongue, the sign some one is "thinking bad of you."

Between godparents and godchildren and between *compadres* there are the usual relations, with intermarriage forbidden. José was named *after his godfather*, who happened to be a priest living in another town. Whenever this *pare* (*padre*) visited San Pedro he would regale his godson with candy or popcorn. There are different godparents for marriage. There is no other class of godparents. I get the impression that the godparent relationship is not nearly as important as in Spanish America, where it seems to substitute for the extended family.

Marriage with any person your mother has wetnursed is also taboo; you call him or her brother or sister, as you do the child of a godparent.

Women have so much milk that sometimes they have to suckle a puppy. An infant is carried on the hip, by a woman; on the back, by a man. An infant or little child wears a necklace of bamboo with a cross as an amulet against the *asuwán*, if not against a bag-carrying, kidnapping bogey called *mangúnupot* (*supot*, bag). Another bogey, *nunud* (grandfather) or *unanu* (midget) lives in a mound in the yard and is angered if a child touches the fruit trees, mango or papaya or lanzon. We are reminded of the grandfather bogey who protects peach trees against our friar-taught Pueblo Indian children.

Schooling begins at six or when a child can crook his arm over his head and touch his ear. The course is for eight

years, but it is much interrupted by services due the household, such as herding carabao or looking after younger children. English is not spoken at home, but it is the school language, a very questionable requirement. José's English is neither grammatical nor idiomatic; he is not thinking in it, and this after living ten years in the United States. What kind of an instrument of thought was it in school? When I was in the Philippines in 1905 and visiting schools it seemed preposterous for all the teaching to be carried on in a language unmastered by either teacher or pupil,[17] and this view has not been modified. José hopes and believes that Tagalog will become before long the official and school language.

In or out of school children seem to have plenty of time to go swimming or to play. Girls as well as boys are good swimmers; girls will swim out to a steamer in the bay with a basket of eggs on the head. Boys play *sipak*, the general ball game in which the bamboo plaited ball rebounds from the body, hands not used; and of a moonlight night after parents are asleep boys will slip out to another barrio to accept a challenge and play a game something like hop-scotch.

Theoretically family supervision or discipline is strict, with much respect for seniors. Parents are served first, the father sitting to the table on his own particular stool, a seat of honor. He crosses himself before eating as does all the family. Children kiss the parent's or grandparent's hand, kneeling, in the Spanish manner. Theoretically the father or male head of the family has the right to kill; instead he whips. José was unfamiliar with our expression of Mediterranean patriarchy, "Spare the rod, spoil the child," but he remarked that in San Pedro whipping is considered good for children. It is a very effectual sanction for obedience, for José says after he had to lie down on his stomach a couple of times when he was three or four years old and was whipped with a bamboo he grew afraid of his father and an order or, if strangers were present, a mere look was sufficient. Once his father whipped his sister, after she was married too, for insulting a cousin by calling her *butang inaamo* (Sp., *puta*, prostitute, *inaamo*, your mother), child of a prostitute. Another sister was whipped for objecting to a suitor acceptable to her father. Women will beat or slap their little maid servants (*alila*), and the girls in turn slap the little children of the family.

Only the Hacendero and a few well-to-do families of the Centre keep servants, boys or girls given away by their father in return for their keep or to meet an obligation. Five children from a poor family in San Vicente work in the Hacienda for nothing, calling their mistress Tia Angé (Aunt María). José's mother had a servant because one year the rice crop failed and the man who was responsible for the crop, since he was working the family's field on shares, gave them his daughter. Unmarried mothers, girls who "have slipped and broken their water jar," may also become servants, since there is nobody to support them or their bastards. Much the same housemaid system is to be found in conservative Mexican villages, but in them the child of a servant would not be kept from playing with other children, as at San Pedro, or outcasted in any way. José, by the way, has a marked sense of caste or class; in making a town map, for example, he did not want to note on it the plaza houses of Nicolás or Pedro or Siriaco the cripple, all "insignificant" men. In what measures such discrimination is derived from Spanish culture or from pre-Spanish slave-holding Tagalog culture or even from American sources in or out of the Islands it is hard to tell.

[17] E. C. Parsons, "Remarks on Education in the Philippines." *Charities and the Commons*, September 1, 1906.

Caciquism, the attitude, as Mr. Taft defined it, that 5 per cent. of the population was fit-to-govern and 95 per cent. only-fit-to-be-governed always dismayed the first Governor-General of the Islands, a very gentle and magnanimous democrat.

Certainly not American and not Spanish is one kind of discrimination in San Pedro: no village girl will marry an uncircumcized boy,[18] since he is considered incapable of begetting offspring. (The father of the family called Supót, Uncircumcized, had to seek a wife abroad. When children were born to him, they were imputed to another man; the village belief remained intact.) Circumcision is generally performed on boys aged eleven to thirteen, sometimes older. José was fourteen. Several boys will be circumcized at the same time, perhaps six or seven; but no formal relationship between these "comrades" is set up. The operation is done very early in the morning in the backyard of one of the boys by a specialist who has planted in the ground a forked branch on which the penis is to be placed, a kind of chopping block for the bolo. The boy is told to look upward and after the V-shaped cut is made he has to spit on the wound the juice of the goyave leaves he has been chewing and then to run a short distance as fast as he can. José recalls that he stumbled and they all laughed. The operator burns some goyave leaves and sprinkles the ashes on the glans which he puts through a jig to hold back the prepuce. For two weeks the boys stay in a little shelter in the bamboo-set yard, to have a goyave leaf decoction applied daily and to observe certain restrictions. They may not eat *malangsa, i.e.*, "anything slimy" such as fish, pork or beef. They must hide away from girls and not even think of them, lest the wound bleed from an erection. If a girl were around at the time of the operation the penis would swell. The foreskin is preserved in a banana leaf, as a suitor's certificate, so to speak, a marriage license.

Of his five "comrades" José remembers only three—Juliano, who happened to be a cousin, and who now goes around with an umbrella, the badge of the pig buyer, Mösis (Sp., Moïse) a seventeen year old who has since become president of the town, and the youngest, a ten-year old, who a year or two later was drowned in a pool near the bamboo bridge of San Antonio. A *sirena*, half fish, half woman, lives in this deep pool and sings and pulls down boys who are warned against throwing stones into the water or in any way making her angry. On the other side of the river women wash their clothes or sometimes with soapweed suds their hair.

Now and again a boy takes to women's ways and clothes, chews betel as girls do and joins their work-parties. These transvestites become expert workers, excelling women in women's work, especially as rice planters or as cooks, so they are very popular as foremen in planting or at fiestas. They do not marry; they indulge in moderate homosexual practices with young boys, masturbatory or caressing cheek-to-cheek. José expressed disgust for American forms of homosexuality, but he appeared indifferent to Tagalog manifestations. However, he knew one *binubae* (*bubae*, girl), effeminate, who must have experienced some disesteem since "*tired of being called binubae* he got married."

At first menstruation a girl must stay home protected against the *asuwán* by garlic in the house or on her person, for that winged visitant from the Igorrote province of Kapís "goes after virgins" as well as pregnant women. Menstruants at any time are expected to stay indoors and not to eat *malangsa* food.

Girls marry soon after adolescence,

[18] According to de Morga (p. 308) the practice was introduced into Luzon by Moslem invaders from Borneo, who preceded the Spaniards by a few years.

say at fourteen, boys a year or so later. There is some courtship at work-parties or fiestas, on the road after dark or in the yard, all surreptitious, or you may get a note to a girl by a little boy. Sometimes a girl's mother allows you to visit, always keeping an eye on you, however. Seduction is a "disgrace in the family," yet seduction or what might be called rape by magic occurs. A man will seize a girl as she goes at night to the store or he will go into her in her own house (*mangagápon*, one who crawls). Acquiescence has already been secured through various practices: he sits in a place the girl has just sat in and left warm; he puffs smoke from the side of his mouth into the girl's face; he crooks his little finger into the girl's finger. Or, if he is desperate, he visits the *mangagawai* and gets a cake to give the girl. The cake has been mixed with the suitor's semen and passed over his genitals. Seduction is broadcasted and bragged about. "I *nagápon* that girl."

José opined that women use no equivalent love magic (or magic of any kind). The girl's charm is in her face and hair; no attention is paid to the body. The complexion should be the typical sepia brown, not too dark. Long hair and "beauty spots," hairy moles, are beautiful. José has a mole near his upper lip which he says the girls envied. The girls will burn a spot on their skin and put charcoal into it to simulate a beauty spot. (More than one cowlick means you have had more than one father.) The nose should not be flat or the face "shallow." The slant-eyed, José calls mestizo, without knowing that the reference is or was once to Chinese descent. (Chinese or Japanese visitors, by the way, are not made altogether comfortable. The *nchik* or *chino* peddler who arrives now and again carrying his bottles by shoulder yoke is plagued by the boys, and Kato, the Japanese who has introduced the making of glazed pottery—he has a San Pedro apprentice as well as a Japanese one—is "under suspicion," as José puts it, without specifying. Kato's wife is Japanese.)

With marriage in mind a youth may go to a girl's father to ask for her, but that takes courage. "Pretty evening, sir!" says the suitor, too bashful ever to greet the girl. They talk of weather and the crops. "If they don't like you, they don't talk much." In such case the couple might elope, subject to pursuit by the girl's father with his bolo. Overtaken in a town, the runaways would be protected by the police.

When the suitor is acceptable or when old-fashioned parents have themselves arranged the marriage (there is no professional marriage go-between) and have the money in sight, as much as ten pesos for church fees and festivity (as there is little money in circulation in San Pedro getting married appears to "cost a lot"), the boy will bring a present of fruit or a bolo to the girl's father, and he offers his services in whatever work there is at hand, tapis clothmaking, netmaking, fishing or farming. For a year the boy will be *tested*, that is the way this kind of marriage by service is thought of, at least by José. During this time also the youth may be building his house, unless according to the more usual plan he and his wife are to live in his father's house, or unless for one reason or another they will live in the house of the bride. The man who lives with his wife's family may not have an easy time; he remains an outsider and may have to stomach from other members of the household such remarks as, "Lucky for you that you have a home with us!" Or perhaps, "You have long legs," the pointed comment made to any one who turns up too often at meal times.

José left home unmarried but not before he fell in love, with a cousin, the daughter of his mother's sister. "You can not marry her," his father said, "she is like your sister"; and he added the stereotype for utter condemnation,

"it would be a disgrace in the family." Any marriage between those bearing the same surname, since they are considered to be related, would be derided in town, a matter for *chismis*, gossip. Curiously enough José does not know that cousin marriage through the third degree is forbidden by the Church. He believes that the children of cousins will be defective, a belief he considers American.

Cousins are called indeed in the same way as brothers or sisters, young ones by name, elder ones by special terms in order of birth. Seniority is based not on actual age, but on age in relation to your parent, *e.g.*, you address as elder brother all the sons of one whom your parent calls elder brother, even if they are actually your juniors. This emphasis on seniority in terminology is consistent with the rôle seniority plays in family organization. To the eldest brother or sister, called *kuya*, the juniors of the household are obedient, particularly on the demise of parents. Inheritance is otherwise affected. The youngest in the family, *bunso*, whether male or female, will inherit the house and, if the family owns fields, perhaps the larger part of the land. Possibly the idea involved here, as in conservative Mexico, is that the seniors have married and have already been provided for. In Spanish folk tales, the youngest brother often has peculiar distinctions.

In the Centre the term *kuya* is no longer used for elder brother or sister or cousin, and uncle-aunt terms are the actual Spanish terms, *tio* and *tia*. "Only the most backward people in the barrios" use the Tagalog term for uncle, which is related to the term for father. (In Spanish America also it has been observed that the uncle-aunt terms may be the first to drop out of the Indian language.) Barrio terms for "my father" or "my mother" also vary from plaza usage. But everybody will still call uncle or aunt anybody their parent calls brother or sister. The "Socrates" José called uncle was not José's father's brother but his second cousin. Terms apart, any upstart junior may be reprimanded: "I have drunk more water than you have ever seen."

Kindred, whether in barrio or Centre, are very free-handed with each other. Whatever they have at hand, salt fish, dried fish, vegetables, they offer freely or they expect to be asked for them by any relative short of provisions. "Do you need this or that?" is a family amenity. Lending, *utang*, is a common practice. Nobody, either relative or neighbor, would ask to be repaid, that would be "committing a sin," but eventually loans are always repaid. In the market of course the attitude is quite different, and people will haggle for two hours or more over two or three cents. Kindred, also neighbors, are often invited in to eat cake and to join the household intent on praying for a bag of rice or a good harvest or for the recovery of something lost.

Divorce is unknown, nor would a woman leave her husband for any reason, not even if he beat her. He might beat her for adultery or even kill her. He does not beat her up when he is drunk. Filipinos are not violent when drunk, says José, they sing.

An elderly widow does not remarry; she would be ashamed before her sons and neighbors. Even a young widow who remarries is criticized by neighbors. "One man in her life" is standardized virtue for a woman. A man of any age may remarry; José says it is in fact Spanish custom for an older man to marry a young woman. However, this is not respectable in Filipino opinion, and in order to remarry a widower would go to another town where he was not known. José and his brothers would respect their father less were he to remarry. Their father is living to-day in Manila, and they do not know whether

or not he is remarried; "he might wish not to hurt our feelings by telling us." Their mother died ten years ago.

The family stood crying around her as she died. "Be good, be humble!" she adjured them in words traditional for a dying parent. "Forgive each other!" To quarrel is a disgrace in the family.

Any one putting his ear to the ground under the bamboo floor might have heard the bones of the moribund woman clinking, a curious variation of the death rattle. As soon as she died the mirrors were covered with white cloth, lest she be seen in them. To give her the last sacrament relatives carried the priest to the house in the church sedan chair (*palanquin*), an interesting instance here as in Mexico[19] of the persistence of archaic things in ritual.

The deceased was sprinkled with holy water (*bandita* from *agua bendita*) by the sacristan. She was laid out on a bamboo table, a crucifix in her hands, and her head to the house altar and the cross on the wall. A candle at each corner. At the wake, the "watching," the younger people played a game of forfeits, tales were told and then after they got tired of story-telling there was a riddling contest (*buktungang; buton*, riddle). Food was served. Prayers were said. People contributed money and flowers. Nothing was placed with the corpse in the coffin. Mourners beat their heads against the wall and wailed until they became helpless. "Don't you know God is taking her?" the others asked. "Will you defy God?" The band played for the funeral procession. The church bell tolled three times. For a man it would have tolled four times. At the grave, more wailing, especially by *bunso*, the youngest child. "How could you leave us?" the children cried, and tried to jump into the grave.

For a month no light was made in the house of the deceased, doors were kept closed and windows screened.

[19] "Mitla," 103 n. 90.

The ghost, *multo* (Sp., *bulto*, Tagalog, *kalalua*), may return within a few days to tell of something forgotten, particularly hidden money. José had heard of a woman returning to tell her husband about some money she had left under the bamboos in the yard and to enjoin him to take care of the children. All this is Spanish lore.

No novena is held for the deceased, nor memorial service. Only "fanatics" wear a black dress or arm band (says José, the modernist). Purgatory is generally out of the picture and except by the rich no prayers are made for deceased individuals, although at All Souls flowers and candles may be taken to the cemetery,[20] where only a very few who are not afraid stay on into the evening by the light of their bamboo kerosene torches, and eat their special kinds of rice cakes and "bamboo cake."

José did not know what his mother died of; she was only thirty-five. She had eight children and had suffered four miscarriages. When José was eight years old he got hookworm, from tossing pennies on the ground, he thinks, and was taken to the hospital in Manila to be cured. In town there are two or three doctors called *mangagamok* (Sp., *albulario*), who set broken bones, treat headache by applying a leaf to the forehead, give internal herb medicines, and counteract black magic. Various ailments are attributed to magic or to poison (*manalasung*) put into the household water jar. Epidemics are caused by such poisoning. During a cholera epidemic American officials prescribed boiled water; but people did not like the taste and when word went around that they would become bald like Americans if they drank boiled water they stopped boiling it.

Spanish witchcraft and Spanish village curer may be recognized at San Pedro,

[20] Situated in the barrio of San Antonio since American occupation; formerly burials were made in the churchyard.

although the usual Spanish terms are not familiar to José, and non-Spanish elements seem to be involved. The *mangagawai* (or *mangkukulan* [one who makes sick]) works his black magic through a small wooden doll (also called *mangagawai*) into which he sticks pins or anything sharp to injure somebody. The doll is used particularly as a spite charm against women. The woman will twitch at the moment the pin is stuck into the doll.[21] Her leg will swell up or she will waste away or she will act crazy,[22] if that is the order to the "doll." The woman may tell her husband who it is who is doing this to her, perhaps a rejected suitor, on his own or through a *mangagawai;* and her husband will catch the man and threaten to kill him. The *mangagamok*—"quack doctor" José calls him—also may discover the *mangagawai,* by sticking a pin or a rice pitchfork into the *nagawaí,* the one bewitched; this makes the *mangagawai* cry out. Burning the doll will make the *mangagawai* sick. Theoretically a *mangagawai* may be hung or burned, but as anybody feels flattered to be called *mangagawai,* according to José, there is probably no danger of an execution, at least to-day.

A *mangagawai* takes offense very easily. You may only have stepped on his foot or answered him in some way he doesn't like. He does not threaten; he has only to show himself near his prospective victim's house for the person to be terrified. Everybody is afraid of him. Men know he has immunity against their bolo. When a family kneels before the house altar in evening prayer to ask for food or for whatever they want—the mother asks and the others repeat after her—they also ask to be delivered from the *mangagawai,* from anybody who can make them sick. You must never show anybody, not only the *mangagawai,* that you do not like him; he may make you sick. Frankness is not merely a lack of courtesy, it is dangerous. Formality is self-protection. With strangers José himself always used stereotype phrases and looked blank. More than once I saw his responsive face suddenly become a mask when we heard footfalls outside the cottage window.

Fear of witchcraft is certainly Spanish, but praying at the house altar for deliverance goes beyond any Spanish practice I know of and suggests some pre-Spanish belief or fear. "*Guniguni,* fear. Our people live all the time in fear of something," opined José. They fear the sun as a god (*poon*) and so at noon or sundown they stay indoors. They are afraid of the dew and of the wind which hits[23] and sickens you (both these apprehensions are probably of Spanish origin). Sin will be punished, *pinibabia,* it is being paid, they say or, *tagalang na Dios,* it is the wish of God, and they are afraid. "María José!" a person cries, if he stumbles, "I am already feeling it." A person is always afraid that something will happen.

There are poisonous snakes in the rice fields (the wound is to be licked by a dog, then ginger is applied, and ginger is given to drink; if despite these remedies death ensues it means that the victim was a sinful man, "God wills it"), but

[21] Unlike the witch of Spanish Indians, the *mangagawai* does not send anything into the body of the victim which has to be sucked out by the doctor. This is purely Indian practice in contrast to the witch doll technique of the Spaniards.

[22] Craziness or neuroticism in a man are otherwise explained or treated. The two insane men José recalls were kept tied to house posts, in the medieval way. Their affliction was imputed to violent experiences: Antonio became insane during the Spanish-American war; Akong, a young man, after he had been tied to a tree and slashed with bolos. The man who broods and then with his bolo runs amok (*sirasiraulu,* broken head, or *masamentau,* bad man, Sp., *loco, juramentado,* † under a vow), killing "to satisfy his anger," is cured by the *mangagamok* with a root decoction. The condition is ascribed to wind or to heat. It is rare in San Pedro.

[23] *Natapal nahang,* the wind slaps, apparently a translation of the Spanish, *se pega aire.*

people are also afraid of the "sleeping snake," a house snake into which at death the eldest son of the house is transformed. (Ancestral snake cult?) Beyond the barrio of Kuyab lives a woman said to be married to a snake. (In the sugar-cane barrio the story goes that a woman is married to a monkey. They have offspring, conceived through the ear.)

People are afraid not only of a whirlpool but to cross any river, perhaps because of a mythical big fish called Bwaiya which can swallow not only all the fish in a river but man or child. "If you do not behave yourself Bwaiya will come," a child is threatened. "It is the wish of God."

Both children and adults are afraid of Tikbálan. When José was small he got lost once in a sugar plantation and began to call out, *Mare, Mare!* Mother, Mother! Tikbálan kept answering, Here! Here! and José followed until he knew it was Tikbálan leading him astray, and he turned his jacket inside out and found his way out of the field. Tikbálan means locust, the destroyer of rice fields, but the spirit of Tikbálan who leads you astray is described as half man, half horse. Tikbálan can also transform into a beggar and if you give him food he can make you sick. If you give him fire your house will burn down. Against such appearances of Tikbálan you may be protected, if not by a hard heart,[24] by Sakai.

Sakai was the leader of a mountain band who fought the Spaniards and when shot at were able to disappear in smoke. Sakai came down into the town and incited people to rise against the Spaniards. When they beat the Spaniards Sakai was their leader, although he remained unseen, and people were grateful to him. Then he withdrew into the mountains. When the Americans came and opposed the people, Sakai came out again, but he could do nothing against the Americans, so he withdrew again to the mountains where he continues not only to afford protection against Tikbálan but to be responsible for good harvests and for hospitality to travelers. Such hospitality is "Sakai's work."

Other cults or magical ways were mentioned by José. There are sacred carabaos: white animals or animals with crumpled horns curved peculiarly up or down. These beasts are not turned out to pasture off rice stalks or zacate grass but are given special fodder, bathed daily and not worked. There must be much more to tell about this, but all I learned were a few tales about the *bakang* (Sp., *vaca*) *ginto*, the golden bull that lived on Makiling mountain, an enchanted or sacred mountain not far from San Pedro, or pastured at the foot of Taal volcano and then went down under the waters of the lake. When American soldiers shot at him he got angry and withdrew into one of the crater lakes so the volcano erupted and caused an earthquake. (Once some American duck hunters shot an ordinary carabao in a San Pedro rice field, and there was a "big row.")

Makiling, Leaning Mountain, the people of San Pedro and of other villages in Laguna Province consider a god, "in poetic language" as José the modernist puts it, *batala*. Of this mountain *batala* the people are descendants. Flood is punishment from Makiling, and once when there was a waterspout, a rare phenomenon, José saw people kneeling in prayer to the Mountain. A small group of people never converted to Christianity are said to live on the Mountain, subsisting on wild rice and wild pig. To kindle their cook fire they blow through a bamboo. Part of the San Pedro folklore about these people, derisive lore, is that to render men continent a woman will

[24] Of the village beggar, one Mariano, they say half humorously that Tikbálan has entered into him.

take a stick to the penis in erection. What don't we say about people we do not know!

Sakai, war leader and culture hero, has been powerful by virtue of his *anting anting*. An *anting anting* is an object of stone or wood which imparts invulnerability, invisibility and the power to transform into an animal of any kind, into bird or snake. Of course José had never seen an *anting anting*, no child has seen one and few adults, but José believes in them, just as he believed in the sacred bolo that hung on his father's wall. Because of its carved handle "God was in it." It was prayed to and "touched," like a saint.

Unlike bolo but like the miraculous ready-made image of Jesucristo of Landayang, an *anting anting* is just found. But unlike image and like bolo it is personal not ceremonial property. Diviners, *manghuhúla*, are possessed of *anting anting*. Perhaps Sakai was a sort of magnified *manghuhúla*.

The *manghuhúla* can foretell not only war but drought or storm, the coming of locusts, the coming of the fearful Bwaiya. He can locate for you a stray rooster or the carabao who does not answer to call or horn, or a daughter who has eloped. A woman will consult him to find out about her husband; married couples, to learn how many children they are to have. A *manghuhúla* diviner lives in the barrio of Kuyab and another in San Antonio.

Ordinary people may divine through dreams, dreaming winning numbers in card playing or in policy. Three and eight are popular numbers. A cockfighter who would divine will listen to cockcrows at dawn. If a cock crows three times under his house, he will bet on his cock, borrowing money from all his relatives, at the next regular Sunday afternoon cockfight, if not at the fight on January 6, "Three Kings" day, or at the big fight for which the patron saint's fiesta is famous. How carefully he has groomed his rooster, rubbing its comb, spraying water or puffing smoke on it, all to make it a valiant bird!

There are many gaps in José's story, but it fills out some of the gaps in our knowledge of Tagalog society, the least studied of Filipino cultures because considered to be the least Filipino. How much Spanish culture prevailed in San Pedro and still prevails, how much it is being encroached upon in language, in manners, in religion or in government through such American factors as railroad, school or Protestantism, students of acculturation may well take note. In the ancient golden age, before the Spaniards, José asserts, "everything was easy to get; people lived well; no *mangagawai*, no sickness; nobody took advantage of a woman or of an enemy." Why, then, in other connections does José use the term *kanunuung*, the grandparents' way, as a derogatory, almost insulting, term? Perhaps José's story will suggest study of a number of things.

EXTRA-SENSORY PERCEPTION: A REVIEW

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THE question whether extra-sensory perception occurs may be stated more precisely as follows: *Is it possible for a person to perceive (or respond to) objects or events without dependence upon the recognized senses?* The name, extra-sensory perception (ESP), covers the essential meaning of a wide variety of terms: telepathy, thought-transference, mind reading, clairvoyance, telesthesia, and cryptesthesia—to mention only the more common ones. But it is free from the special explanatory hypotheses and associations which some of the other terms have acquired.

The problem of determining whether ESP occurs is important at this stage in the history of psychology not because of practical interest in the possibility of extending the range of human perception—important though that may be. It is important primarily because the scientific world has settled down to the assumption that this extra-sensory class of phenomena does not occur, that it is, on a priori grounds, impossible. The trend of scientific thought regarding the relation between mental processes and the physical world has, since the days of Aristotle, followed the lead attributed to that philosopher himself: "Nihil est in intellectu quin prius feurit in sensu." To find, therefore, ever so slight an exception to this sensorial-physical conception would presumably have the same revolutionary consequences for modern psychology that the discovery of ever so small an exception to Aristotelian astronomy had for that science in the days of Galileo. The observation of the moons of Jupiter had no need to be practically important (nor their nature understood) in order to turn the world about.

The question of the occurrence of ESP has arisen from the frequently reported ("psychic") experiences of persons of all races and periods, experiences in which there is represented awareness of events under circumstances that would appear to exclude sensory perception. The more familiar of these spontaneous experiences consist of veridical dreams; hallucination-like awareness of distant scenes in the waking state, such as Swedenborg's reported vision of the Stockholm fire; apparent monitions of danger, such as those reported as occurring to Socrates; coincidental experience of the same pattern of thought by two separated persons. The reports of such phenomena and the attendant circumstances must either be wholly discredited or else they remain a challenge to the psychologist. Historically, then, it is out of these recurrent human experiences that the persistent question has emerged whether there may not be an extra-sensory mode of apprehending reality.

HISTORY

Throughout most of the cultural history of the race, belief in an extra-sensory order of perception was based upon such spontaneous experiences. They have been almost universally taken as a sufficient basis for the assumption of supernatural powers among religious groups and extended powers of perception have been attributed in most of the known religions, not only to divinities and spirits, but to religious leaders, prophets and sometimes to the ordinary layman in moments of special religious significance. Many philosophers, too, from Plato to Hegel, have simply assumed the occurrence of extra-sensory perception, with

no other support than that of the anecdotal evidence.

Among disciplines more accustomed to observation, at least of the "clinical" or "field" type, these spontaneous experiences have been noted and reported as incidental data. Psychic research societies have collected them for study. Anthropologists have placed on record the experiences and demonstrations of primitive people that appeared to represent extra-sensory perception. Medical men through the long history of Mesmerism and hypnotism found many occurrences of the type under discussion. Psychiatrists (Freud, Jung, Stekel and Janet) have encountered the phenomenon in an incidental way in the clinic. But while these secondary observations have served to keep the question open, they have added little, if anything, to the evidence upon which the answer must be based.

The direct experimental investigation of the occurrence of ESP has extended over a period of about sixty years, having begun with the formation of the Society for Psychical Research in England in 1882. Since that time, there have been 145 reports of systematic investigations of this kind, totalling 4,918,196 trials.[1] This great mass of test results represents the work of a wide variety of types of investigators and the use of a wide range of methods of testing. Of the 145 reports issued, 61 were by psychologists, 39 by other academic men, 18 by non-academic professional men and 24 by laymen. The great majority of the reports written by psychologists have appeared during the last six years. The conditions and methods represented in these reports vary so widely, however, that there is no point to a discussion of their results as a whole. While in the main (to the extent of 73 per cent. of the total number of reports) the authors were led to the conclusion that extra-sensory perception occurred in their experiments, it is only upon a closer analysis of results in terms of experimental conditions that any final judgment can be reached as to the present status of the ESP hypothesis.

[1] These and other figures in this paper are taken from "Extra-Sensory Perception after Sixty Years," by J. G. Pratt, C. E. Stuart, Burke M. Smith and myself, of the Parapsychology Laboratory of Duke University, with the collaboration of Dr. J. A. Greenwood, of the Department of Mathematics of Duke University; published by Henry Holt and Company, New York, 1940.

Criteria

Before it can be determined how crucially the test results bear upon the question of ESP, it is necessary (1) to formulate still more precisely what that question is, (2) to describe at least in a general way the common test procedures used to investigate it, (3) to consider what alternative or counter-hypotheses might conceivably be applicable to the results obtained with such test procedures, and (4) to consider what criteria are demanded for a conclusion.

Formulation. The question of the occurrence of extra-sensory perception as clarified for the simplest conceivable experimental attack is stated as follows: *Is it possible repeatedly to obtain results that are statistically significant when subjects are tested for knowledge of (or reaction to) external stimuli (unknown and uninferable to the subject) under conditions that certainly exclude the use of the recognized sensory processes?* This statement of the problem is intended to avoid all assumptions as to the nature of ESP, its distribution among the general population, its psychological character or the regularity of its function. For example, it is not assumed that every one or any given person has ESP ability or that those who may show it on one occasion will necessarily do so on all test occasions. It is not assumed that it is a conscious process and that therefore a subject would be able to discover deception practised upon him by the experimenter. Finally, although it is essential

to the testing of the ESP hypothesis that there be recurrence and repetition of ESP performance, it is not a part of this primary step to investigate whether it is invariably repeatable on demand by a given experimenter or under a given set of conditions. These and all other unnecessary assumptions are excluded at the start by the definition of the experimental problem.

Methods. In general the procedure required for the investigation of the ESP hypothesis would consist first of arranging for a specifically limited range of objects, symbols or other target material to be perceived. This restricted selection of objects is required by the need for statistical treatment, the only method which at this stage of investigation of ESP can solve the difficulty of determining what is due to chance and what may be attributed to other factors. So long as an uncontrollable or spontaneously occurring phenomenon is under investigation, there is no other way of appraising the test results than by statistics. (If the analogy of seventeenth century astronomy may be followed one step further, it could be said that the statistical method has been to the problem of ESP what the telescope was to extra-Aristotelian astronomy.) There has indeed been a considerable amount of work done in which no statistical evaluation could be made; that is, it was impossible to estimate what chance alone would have given. But such work commonly permits no very definite conclusion.

Given a fixed number of objects as a basis for the subject's perception, these objects must of course be completely removed from the range of sensory experience. If a deck of cards is used, as has most commonly been the case, the cards will of course be kept in the inverted position. A great deal of the earlier work was done with no further precaution than this. However, with greater concern about the validity of the conclusions, various ways of screening cards still more completely from sensory perception by the subject were introduced—methods such as enclosure in sealed opaque envelopes, the interposing of solid wooden screens or the separation of the cards and subject by placing them in different rooms.

The subject might be asked simply to call aloud what he thinks the symbol on a designated card is (for example, the top card on the deck), or he may be given materials for making his own record. A very common departure from these procedures (which are both designated as "*calling* methods") is the *matching* procedure for identifying the card or object. In this, the subject is given a deck of cards and requested to match them one by one against a set of key cards—the key cards consisting of the different suits of symbols represented in the deck. The matching might be done also by having the subject simply point to the key cards while the experimenter handles the deck of cards to be matched, or electrical keys may be introduced (one for each key card position) when the subject and the cards are separated by some distance. There are numerous modifications of both the calling and matching methods.

Viewed from another angle, there are two general types of ESP tests; namely, that in which an *objective* stimulus is to be perceived and that in which the *subjective* states of another person are to be apprehended. The first, or objective ESP test, is commonly called *clairvoyance* and the second, or subjective ESP test, *telepathy*. These two types of test may both be combined in a single test condition which may allow both for the direct apprehension of an object and of the mental experience of a person looking at or otherwise sensorially perceiving an object. These three general conditions might be designated as pure clairvoyance, pure telepathy and general ESP tests. Unless it is otherwise stated, the research to be discussed below will be of the pure clairvoyance type. This has

been mainly used because of the greater ease of obtaining conditions adequate to guard against sensory or other cues.

Counter-hypotheses. Before any experimental work could be said to establish the ESP hypothesis, there must be left no other conceivable hypothesis that could possibly explain the results. Not only must every other single conceivable hypothesis be excluded as inapplicable to the results, but all combinations of possible counter-hypotheses must likewise be shown inadequate to account for them. This is necessary in the introductory stage of every field of investigation ushering in a new principle. It requires a careful assembling of all conceivable alternatives in what would seem otherwise an unwarrantedly defensive manner. It is for the investigator himself, however, the only way of rigorously testing the interpretation and bearing of his results.

In the volume mentioned above, "Extra-Sensory Perception after Sixty Years," the authors list 35 counter-hypotheses which have to be shown to be inapplicable, taken singly and jointly, to the ESP experimental results as a whole. For brevity, however, it is possible to deal with these 35 hypotheses under 8 general headings as follows: Hypotheses (1) related to chance, (2) dealing with selection, (3) based on practices of the subject, (4) assuming shuffling defects, (5) dealing with errors in the records, (6) involving sensory leakage, (7) supposing incompetence on the part of the experimenter, and (8) concerning the general logic and conclusions of the research. To establish the ESP hypothesis by experiment, then, it is necessary so to design the experimental procedure that no habits or practices of the subject could consciously or unconsciously affect the conclusions; no card defects, recording errors, sensory leakage or other effect of experimental incompetence could enter into the production of favorable results. It is necessary to show likewise that no improper selection of data occurred. If the experimental procedure adequately guards against all these alternatives and the results are still unexplainable by chance, presumably the experiment has demonstrated extra-sensory perception in the sense defined and to the extent that the formulation of the problem was a proper one.

Amount of evidence. The further question arises, then, as to the finality of a single experimental study or, in other words, the question as to how much of independent repetition is required before the conclusion is established. This is a matter of individual judgment into which many factors enter, among them the degree of confidence in the general competence of the experimenters. Commonly in scientific matters which do not conflict with current conceptions, a few single independent repetitions are tantamount to full establishment. Probably for most students of the literature in extra-sensory perception likewise a few independent confirmatory reports from a psychological laboratory, based on conditions which meet all conceivable counter-hypotheses, would be adequate for establishment. There will, however, be many persons who will demand a large number of independent confirmations and the individual requirements will be various. There is no arbitrary criterion of judgment upon which to rely. For this reason "general scientific acceptance" is a very relative and uncertain matter.

Results

In turning now to the experimental results, it is necessary to confine attention to a relatively small portion of the total number of trials mentioned above. This is due largely to the fact that most of the 145 studies reported were made at stages of methodological development that are now greatly outmoded. Only work reported during the last six years meets the standards now followed as a basis for judgment, and even a considerable portion of that must be set aside as

suffering in some point from lack of necessary precautions. This is, of course, not to say that all or any of the work set aside may not constitute genuine instances of the operation of ESP; it is rather to say that it can not be regarded as crucial evidence of ESP as long as there is recognizable possibility of some one or other of the counter-hypotheses being applicable.

Sensory cues. By pruning out all results which were not obtained under conditions in which the objects (mostly cards) to be perceived extra-sensorially by the subject were not completely excluded from sensory contact of any kind during the test, and by excluding all blocks of data which can not be reliably evaluated (*e.g.*, radio test results), the 4,918,196 trials are reduced to 907,030. This summary represents the pooling of 30 different researches by 24 different authors and includes all work quantitatively evaluable that meets the standards laid down for preventing sensory leakage. The 907,030 trials gave an average score of 5.36 hits per 25 trials (in which 5 is the mean chance expectation). This means that there were 13,199 hits above the number expected by chance. This deviation is 39.9 times the standard deviation.* This last measure, the critical ratio,† is far beyond the usually accepted criterion of significance, a criterion which ranges from 2 to 3 among different groups of statisticians.[2] There are several other measures of statistical significance to which the data might be subjected and by which they are also significant. The various subdivisions of the results according to condition of screening (opaque envelopes, wooden screens, distance) are themselves highly significant; and of the 30 independent studies contributing these results, 24 gave significant total deviations under the conditions.

Recording errors. It is worth while also to consider the results of ESP tests made with a still further set of safeguards, those which were done with special measures taken against the possibility of recording errors. There has been, it is true, no discovery of significant results attributable to recording errors, even though considerable attention has been given to this subject during the last few years. Nevertheless recording errors do occur and it is of importance to know in what portion of the research just mentioned such errors could not have affected the conclusion even if they were made. If only those results are taken which were obtained under the condition of independent recording by different persons of cards and calls (or key cards), the number of trials is 220,455 and with this group the average score is 5.23, deviation 2,090 and the critical ratio 11.12. Again the subdivisions of the results according to ways of screening the cards from sensory leakage are each independently significant, and six of the ten individual studies are likewise.

Competence and trustworthiness. During recent years the intensive search for all possible alternative hypotheses has led some experimenters as well as critics to raise the question of the competence and even of the trustworthiness of the investigators. Unusual among scientific workers though this may be, it is a legitimate concern in a research that may have radical consequences to scientific thinking. This has led to a number of experiments being conducted especially to deal with the matter. There has been a total

* *Standard Deviation:* A unit of measurement in statistical method; that deviation above and below mean chance expectation which is expected to include about ⅔ the chance scores. For ESP cards, the theoretical standard deviation is approximately 2.04, no. of runs.

† *Critical Ratio* = C.R.: The observed deviation divided by the standard deviation.

[2] The methods of evaluation applied to the ESP data did, of course, not originate with the ESP research, but are taken from mathematical statistics. They have had the approval of mathematicians of probability, as expressed on various occasions, among the most authoritative being the statement of Dr. Burton H. Camp, president of the Institute of Mathematical Statistics.

of 72,750 trials made in which, along with all other precautions mentioned above, there were *two experimenters present at all times* during the experiments and the conditions were such that a mistake by one would have been detected by the other. These results give an average of 5.29, a deviation of 845 and a critical ratio of 7.82. Four of the six studies contributing to this total were individually significant.

Counter-hypotheses, jointly considered. There are other hypotheses that have to be weighed with the experimental findings, but they are of lesser importance and do not warrant space in this brief review. But there is a need to line up all the research which meets all the counter-hypotheses taken jointly, and to present it in condensed form. The most recently published work is, as might be expected, best fitted to meet the alternative hypotheses by specific measures taken. This is the work of Pratt and Woodruff of this (Duke) University. In this study, the additional provision was made for a written statement (made in advance) of the expected length of each experimental series. Upon submission of this statement to the record librarian of the Parapsychology Laboratory, in which Pratt and Woodruff worked, the experimenters were issued a requisite number of record sheets which were serially and identifiably numbered. This procedure insured against two variations of the selection-of-data hypothesis, one of these being the possible inadvertent loss of record sheets and the second that of the experimenter's optionally stopping the series at a point of advantage (that is, at a point at which the score average had reached a favorable level). Along with these safeguards went, of course, all the accumulated precautionary measures which had become a part of the test procedures. The 60,000 trials reported by Pratt and Woodruff were significant, having given a critical ratio of 4.99. (The average score was 5.20 and the deviation 489.)

While there is as yet in print only one study having the full precautions of the Pratt and Woodruff study (others are in manuscript), there are certain others which in effect meet the full range of counter-hypotheses, taken singly or together. Touching only briefly upon each instance, several of these might be mentioned here. First (also first in point of time, since it began in 1933), there is the Pearce-Pratt series conducted by two experimenters, Pratt and myself, with the subject, Pearce, in one building and the cards, handled by Pratt, in another. In a part of the series a distance of 100 yards separated the buildings used; and in the other part of the series, the distance between the buildings used was 250 yards. Duplicate records, independent checking, and other essential safeguards were introduced. In one series of 150 trials (average 9.3) the experimenters, Pratt and myself, were both present during each run. The results were highly significant, giving an average of 7.53 for 1850 trials and a critical ratio of 10.87.

A third case meeting all the requirements is that reported by Warner (formerly of New York University), consisting of 250 trials made with one subject at a single session. In this instance, the subject was in a separate room with a one-way signalling device by which she could communicate readiness for the next trial to the experimenters who were located on an upper floor in another part of the house (that is, not immediately overhead). There was a distance of about 35 to 40 feet between the subject and the position of the experimenter and his assistant. In this, as in the preceding instance, the subject made her own record while the experimenters recorded the cards. The call and card records were thus independently made, with two experimenters present throughout the experiment and the check-up. The average was 9.3 hits

per 25 trials, and the critical ratio was 6.8.

The fourth case to be mentioned is outstanding in several features, but particularly in its high score average. This is the study reported by Riess of Hunter College. The tests were made with a distance of more than a city block between the cards handled by the experimenter and the subject attempting to call them. Under these conditions in a series of 1,850 trials, the subject averaged 18.24 hits per 25, in one instance scoring a perfect run of 25 hits. There was not in this series the two-experimenter set-up that characterized those just reviewed, but to some extent the openly expressed critical attitude of Riess, together with his reluctance to associate himself with the field of ESP research by publishing his results would argue strongly against the supposition that the results obtained were the result of error motivated by the desire to prove the ESP hypothesis. The Riess tests were not of the more common pure clairvoyance type but were based upon what is called the general extra-sensory perception or GESP condition (that is, the experimenter looked at each card as the percipient was attempting to call it, thus allowing for both telepathy and clairvoyance).

The fifth study to meet all the requisites is a pure telepathy test series conducted with separation of the agent and the percipient (sender and receiver) by distances ranging from 165 to 300 miles. In this series, the experimenters were Miss Ownbey (now Mrs. George Zirkle, of Hanover College, Indiana) and myself. In a total of 650 trials, there was an average score per 25 trials of 6.8 and a critical ratio of 4.6, which is very significant. In this series the experimenter, Miss Ownbey, was trained to select the five symbols (circle, rectangle, plus, star and wavy lines) in random order—an order which would not be inferable nor patterned in any repeatable form. Various cross-checks in the data show that this goal was achieved and that the hypothesis of patterning does not apply either to the subject's calls or to the experimenter's selection. In this series one score of 19 and two of 16 were obtained. The records were made independently and were turned over at once to the second experimenter.

There are many other series which almost meet the full array of counter-hypotheses; for example, a study by Murphy and Taves, of Columbia University, that is thought to need certain recently suggested statistical corrections. The work of Martin and Stribic at the University of Colorado has not completely met all the latest requirements for safeguarding against errors of recording. The Pratt and Price study of this laboratory suffered only from the lack of permanent records of individual trials, the experimenters relying upon duplicate counting and independent recording of scores instead. These will illustrate what might be designated as the technically incomplete portion of the ESP research. In most instances the hypothetical technicality on which a series of experiments is ruled out is one which is not itself based on any real demonstration of error but rests upon a logical possibility.

Does ESP occur? Whether or not it may be concluded that ESP is a valid phenomenon in nature is necessarily a somewhat individual and relative matter. It will probably be agreed, however, that almost any other scientific hypothesis would, if supported by the amount of evidence that supports this one, be regarded as established. Certainly it may be said that unless or until some new counter-hypothesis is offered to give new issue to the interpretation of the present results, there is no very reasonable alternative to acceptance of the occurrence of ESP as established. Those who will find it difficult to take this position must, it would seem, have recourse either to a general rejection of scientific method or to a general faith

(always a possibility, of course, in any field) that some further alternative hypothesis will yet turn up. Some readers may simply have insufficient confidence in scientific method to accept, whatever the evidence, the occurrence of a phenomenon which they can not explain. For such as these time and further research developments will be needed for a final settlement of the question.

The Nature of ESP

Distribution. The first general question that arises regarding ESP, once it is accepted, is that of its distribution. What percentage of people possess such ability and what kind of people are they? The efforts to answer these questions have been in the main only incidental to the endeavor to investigate the existence of ESP. But investigators in different parts of the world have naturally worked with groups of a considerably wide geographic distribution, with some differences in race, age, sex, intelligence, sensory acuity, normality, and other characteristics, and the comparisons are available.

As to the percentage of persons capable of demonstrating ESP in tests, there is so much variation in test performance, due presumably in part to conditions under which the tests are taken, that estimates are of little value; and in any case statistical results do not permit rating of individual performance with anything more than a probability. The tentative estimates that have from time to time appeared—that roughly 20 per cent. of the population tested might be said to have shown ESP ability—can not be taken with any finality and would not be necessarily applicable to every group of subjects or experimenters. Precise information on distribution will have to wait for further enlightenment in the control of the ability requested.

It is, however, of considerable value to have the elemental facts that successful performances in ESP tests have been reported from different countries, and that a variety of groups and classifications of people have been tested, with the general result that no outstanding group differences have been found. While the investigator is usually hopeful of being able to associate ESP ability with some biological, anthropological, or personality characteristic, it has not yet appeared that there is any such association. Both normal and abnormal subjects have been successful, as well as both blind and seeing, highly intelligent and subnormal, young and old, male and female, hypnotizable and non-hypnotizable, hypothyroid and hyperthyroid.

All this suggests that the ability is not a superficial acquisition, not an odd and isolated development, but something which is perhaps a deeply imbedded property of the personality in all its diversified forms. This, however, is nothing more than a suggestion.

Conditions that influence ESP. Turning to the conditions that affect performance in ESP tests, determining success or failure, quite a different picture is found. Here are at least many definite findings, though some of them must be taken with reservation because there are always, in experiments with human subjects, many conditions within the subject's own personality that can not be either evaluated or controlled.

It is demonstrated that the conditions of the experiment in general affect performance. First, physical conditions of the subject; second, conditions of motivation; third, cognitive differences in the test; fourth, perhaps overlapping with the second, the social situation of the tests; and fifth, the test procedures themselves appear to have some effect.

As an example of the effect of physical conditions of the subject upon performance, it is indicated that large doses of a narcotic drug, sodium amytal, one that greatly hinders general mental functioning, adversely affects ESP performance and is counteracted by caffeine—which physiologically counteracts the dissocia-

tive effect of the narcotic. In the realm of motivation, it is likewise indicated that rewards, competition, novelty of test material and other conditions tending to arouse interest in the task seem to help performance; whereas making the test run unduly long, withholding information regarding scores when the subject wants to know them, and otherwise frustrating the interest of the subject tends to lower the score.

There is sufficient data to suggest that there is a considerable cognitive value to the limitation of the range of choices in a test to the neighborhood of 5; that is, if more than 5 suits or types of symbol or object to be guessed are used, there appears to be a decline of efficiency obtained, as is likewise true going in the other direction and using a smaller number than 5. Trance, either hypnotic or self-induced, seems to be as yet of no demonstrated effect.

There is evidence, too, to indicate that the personal relations between subjects and experimenters are determinative of success. Some experimenters evoke favorable working relations and others fail to do so. The presence of visitors or the conduct of the tests with subjects in groups have in general given much lower scores than with the individual subject working in relative isolation.

While the calling and matching procedures are approximately equally successful, certain modifications of both of these have proved in general less favorable to high scoring. For example, in the calling procedure if the cards are not removed from the deck one at a time and the trials thus separately indicated, there is apparently a loss of efficiency. In the matching procedure, if the key cards are inverted, the results are generally lower than if they are exposed—even when the deck to be matched is itself completely screened from view in both procedures.

Physical relations. No physical characteristic of ESP has as yet been discovered nor even a suggestion that there is such. The one outstanding feature that runs through the sixty years of ESP experiments is the sharp departure of ESP test results from what would be expected if known physical processes were responsible. There is available in present physical knowledge no hypothetical intermediating energy linkage between stimulus and percipient that meets all of the conditions under which ESP has been found to occur. These conditions can only be outlined in the present space. No one of the single findings in itself warrants the view just expressed regarding the inapplicability of physical law to ESP results; this is rather a reflection of the total picture presented.

There is first the absence to date of any physical condition of the stimulus found to be inhibitory in ESP tests. Sizes, shapes, angles, concealment or enclosure of the stimulus object do not prevent effective ESP performance. Objects may be superimposed upon each other, as in the test of calling "down through" a pack of cards, in the close proximity of 100 to the inch. They may be separated from the percipient by distances of hundreds of miles with intervening terrain of mountainous character. Subject and object may occupy positions with respect to each other involving various angles. The physical nature of the stimulus itself may vary widely. It may even have no known physical constitution, as for instance in the pure telepathy tests in which the subjective state of another person is apprehended. All together, these findings require either a physical process that is considerably unlike anything that is known to-day or else a process that is extra-physical. But perhaps such a distinction at this stage is not very meaningful.

Psychological relations. It may be stated with certainty that considered as a psychological activity the process of extra-sensory perception is entirely unconscious and has rendered little or

nothing that is fruitful through the methods of introspection. In its performance it has been generally erratic and as an ability it appears highly unstable. There is no adequate evidence as yet of its development through use, and although it is subject to voluntary control to a certain extent—namely, to the extent of directing it toward given objects and toward either hitting or missing—this control may be regarded as largely the direction of application or utilization. The immediate activation of the process is apparently spontaneous and involuntary; that is, the subject can not from moment to moment say whether he is going to perceive extra-sensorially or not; any more than he can with certainty tell in retrospect whether he has done so or not.

ESP, too, is a "diametric function"; when two cards are to be matched, neither one of which is known, it has been shown that the mind takes a short cut—that is, it does not first identify one and then the other and then decide they are alike or unlike. It seems to decide simply that they are alike or unlike as a unitary act. This is called (by Foster) "diametric" because it cuts across, as it were, instead of going around to arrive at the final judgment step by step.

Finally extra-sensory perception and sensory perception appear to be much alike except in the relation of the subject to the stimulus. When sensory perception is tested at a low level of stimulus intensity which makes the process more comparable to ESP, there is indication that it is subject to some of the influences now known to affect ESP performance. More investigation of this important line of comparison is needed and is being undertaken. On the other hand, when compared as to the relation of the percipient to the stimulus object, there is a vast difference. ESP is responsive to an enormously wider range of stimuli and of conditions of stimuli than any known sense modality; it is independent of bodily orientation to the stimulus; it does not permit introspective localization of reception; and it functions under conditions for which no known stimulating energy could intermediate. A question arises then in the psychology of ESP (comparable to the final question on the physics of ESP) as to what this apparent lack of stimulation means in the general view of the relation of the ESP subject to his environment. Is it a question here of perception without mechanical intermediation? Or is there an energetic determinant of the ESP results that escapes the classification and criteria now embraced by the curricular physics of the moment?

Again it may be that the distinction implied by these alternatives is less important than has been hitherto thought —conceptions of "physicality" may change and may at best be mere academic boundaries; nevertheless it is our *present* knowledge (not that of the future) by which we must be guided, and according to this, whatever its worth and its permanency, there is a marked dichotomy between the workings attributed to ESP and those of the sensory-mechanical world with which science has hitherto had its main dealings.

How far such a break with orthodoxy is justified calls for the greatest caution in the determining; for if the step is a fully warranted one, the scientific reconstruction that must follow is probably far beyond present-day capacity to realize. But by this very eccentricity of the consequences of the ESP hypothesis may be measured roughly the shift of center and the resultant shift of scientific perspective of the universe which logically must follow in the fullness of time and with continued research. What has been found thus far is something to be explained, and later incorporated, in a much enlarged world of knowledge, more than it is a step in enlightenment itself. The investigation has been opened instead of closed.

JOSEPH CONRAD AS A GEOGRAPHER

By FLORENCE CLEMENS
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THE whole commercial world looks with increasing interest toward the far-flung Malaysian isles. Since early times, when European nations fought for the spice trade in that remote and vaguely charted archipelago, until to-day, when practically every particle of it is "protected" by some non-Asiatic country, those rich and desirable islands have exerted their magnetic influence. The energetic, ambitious white race continues to convert them from their original wilds into plantations and mines and trading centers, but vast portions remain difficult of penetration and yet unexplored, both enticing and repellent.

The geographical background of Joseph Conrad's Malaysian fiction has long excited critical interest. It has been praised as a wonderful harmonious accompaniment to his plots and to the moods of his characters. Editions of his books have been published containing maps, showing the main centers of his stories. With all this its importance has not yet been fully appreciated.

In spite of its vividness and charm, Conrad's picture of Malaysia is, of course, subordinated to his chief purposes. This strange, remote scene isolates his characters and situations, cutting them off from their ordinary backgrounds and so concentrating an intense light upon them. They become laboratory specimens, segregated for microscopical examination. It is this peculiar method which makes the reading of one of Conrad's Eastern novels a breath-taking experience. Lay aside the plot, however, and there remains a body of literature which should fill the heart of any true geographer with delight.

It will be remembered that Joseph Conrad's experience in the East was confined to that of a seaman. For a decade, from 1878 to 1888, he saw much of the region as sailor, second or first mate, and finally as captain. Naturally he visited coastal parts and sections up the rivers which led to trading towns. Of the *far* interiors he saw nothing, nor does he seem to have gone much beyond the ordinary routes of his boats. No one writing of the Indies, however, has possessed a more sensitive and receptive mind, a mind of more photographic accuracy.

Conrad first saw Malaysia sixty years ago, but much that he wrote is as true to-day as it was then. Conceded that he by nature had a strong sense of actuality, his training for the sea undoubtedly strengthened his power of direct, exact observation. His memory, too, was very tenacious, and these powers, augmented by his wonderful expressiveness, have resulted in the valuable record of the Malaysian scene included in his fiction. No one should be misled into feeling that Conrad's Malaysia is fictitious because of the stories. As captain he was obliged to follow charts with perfect precision. It became habitual with him to be true to exact geographical positions in his writing, also. Perhaps his experience would have led him to feel guilty about being otherwise. Altogether he used about one hundred place names, and nearly all of them can be found by searching the maps.

Conrad wrote five novels and twelve short stories, placed somewhere in that part of the East which includes southeastern Asia and the island world between it and Australia. "Malaysia" is an elastic term, usually restricted to the East Indies and the Malay Peninsula,

the supposed home of the true Malay, but sometimes extended into a wide territory in which lie the settings of all Conrad's Eastern fiction—from Mauritius in the west to the Solomon Islands in the east. A study of the fiction produces a true impression of the general topography of this area as well as innumerable clear-cut close views. We become acquainted with "the shallow sea that foams and murmurs on the shores of the thousand islands, big and little, which make up the Malay Archipelago."[1] We are shown the contrasting barrenness, fertility and rank wilderness which the islands have to offer. "Out of the level blue of the shallow sea Carimata raises a lofty barrenness of grey and yellow tints, the drab eminence of its arid heights. Separated by a narrow strip of water, Suroeton, to the west, shows a curved and ridged outline resembling the backbone of a stooping giant."[2] These sterile bits of land are quite unlike Bali's "terraced fields . . . (and) murmuring clear rills of sparkling water that flow . . . down the sides of great mountains bringing life to the land and joy to its tillers,"[3] or the jungles, the "luxuriant vegetation bathed in the warm air charged with strong and harsh perfumes, the intense work of tropical nature . . . , plants shooting upward, entwined, interlaced in inextricable confusion, climbing madly and brutally over each other in the terrible silence of a desperate struggle towards the life-giving sunshine above—as if struck with a sudden horror at the seething mass of corruption below, at the death and decay from which they sprang."[4]

This fiction should be read with atlases and geographies at hand. They prove that Conrad may be trusted as a geographer. For example, consider his description of the lower Meinam River as compared with those of geographers. Conrad became acquainted with it when he went to Bangkok in 1888 to take charge of the *Otago*. Elisée Reclus in his "Asia" describes the basin of the Meinam (variously spelled, as practically all native words used as geographical names in Malaysia are) as follows:

> Although less extensive than the other great Indo-Chinese fluvial basins, that of the Menam, or "Mother of Waters," occupies a more central position, and has thus played a leading part in the historic evolution of Farther India. Uniting its waters with several other rivers in a common delta, it reaches the coast at the northern extremity of a gulf, which penetrates far inland, and which presents a seaboard of no less than 900 miles. The entrance of the Menam thus forms the central point of a vast circle, towards which converge all the sea routes on the one hand, and on the other all the highways of the river valleys. . . . The Menam rises in the Lao territory and throughout the whole of Siam proper is navigable by light craft, while steamers ascend its lower course with the tides. . . . At the head of the gulf a crescent of submerged sandbanks, stretching some 60 miles east and west and accessible to vessels of 500 tons only at high water, separates the sea from the plains of Bangkok, which at one time formed a northern continuation of the gulf.[5]

In "The International Geography," edited by Hugh Mills, are these sentences:

> The heat of the great alluvial plain is tempered by its proximity to the gulf. . . . The amount of moisture in the atmosphere, however, makes the climate of the lowlands peculiarly trying.[6]

Ernest Young's travel book, "Siam," offers this description of the river:

> Siam has only one great river that is entirely her own. It is marked on English maps as the "Menam," but the real name is "Menam Chow Phya." . . . The Menam is not merely the mother of the waters, but of the land also, for all the lower part of Siam is one extensive plain, which has been built up by the mud, gravel, and

[1] "The Rescue," p. 3.
[2] *Ibid.*, p. 5.
[3] "Almayer's Folly," p. 174.
[4] *Ibid.*, p. 71.
[5] New York: D. Appleton and Company, 1895, Vol. 3, pp. 458–459.
[6] New York: D. Appleton and Company, 1900, p. 509.

sand brought down from the mountains by the river.

Suppose we get on board a steamer and sail from Bangkok down to the mouth of the Menam. The distance from Bangkok to the mouth of the river, measured as the crow flies, is only twelve miles, but so much does the river twist and turn that we shall be three hours before we reach the sea. . . .

By this time we are at the mouth of the river. Here the current of the river meets the sea. That current is bearing with it tons of fine sand and soil. But the sea seems to say to the river, "Thus far, and no farther." And so here all the muddy stuff in the river water is deposited. In this way a bar has been formed, which blocks the river mouth. At low tide there are only three feet of water over it, and even during the highest tides there is never more than fifteen feet of water on the bar. Hence very large steamers can never enter the Chow Phye, but have to load and unload their cargoes by means . . . of lighters.

The chief attraction at the mouth of the river is a magnificent pagoda known as "the Shrine in the Middle of the Waters." It stands on a little island, is built of whitewashed stone and bricks, and is surrounded by the buildings of the temple of which it forms a part.[7]

On page 468 of Reclus, "Asia" is a map of the Meinam from Bangkok to the gulf. The line of the river executes great looping meanders between the city and the mouth. Midstream on the last big curve is the island with the pagoda, marked "Pahnam." The depth of the water at the mouth of the river is given. The mid-channel measures only three to sixteen feet, and the extensive mud bars indicate how difficult navigation is. The coast is shown as very low.

Now, how does Conrad describe the river? A series of quotations will tell:

There were no pilots, no beacons, no buoys of any sort; but there was a very devil of a current for anybody to see, no end of shoal places, and at least two obviously awkward turns of the channel between me and the sea.[8]

There was a shallow bar at the mouth of the river which ought to have been kept down, but the authorities of the State were piously gilding afresh the great Buddhist Pagoda just then, and had no money to spare for dredging operations. I don't know how it may be now, but at the time I speak of that sandbank was a great nuisance to the shipping. One of its consequences was that vessels of a certain draught of water, like Hermann's and mine, could not complete their loading in the river. After taking in as much as possible of their cargo, they had to go outside to fill up. The whole procedure was an unmitigated bore. When you thought you had as much on board as your ship could carry safely over the bar, you went and gave notice to your agents.[9]

I could not detect the smallest dot of a bird on the immense sky, and the flatness of the land continued the flatness of the sea to the naked line of the horizon.[10]

Eighteen miles down the river you had to go behind him, and then three more along the coast to where a group of uninhabited rocky islets enclosed a sheltered anchorage. . . . There was nothing to look at besides but a bare coast, the muddy edge of the brown plain with the sinuosities of the river you had left, traced in dull green, and the Great Pagoda uprising lonely and massive with shining curves and pinnacles like a gorgeous and stony efflorescence of tropical rocks.[11]

And when I turned my head to take a parting glance at the tug which had just left us anchored outside the bar, I saw the straight line of the flat shore joined to the stable sea, edge to edge, with a perfect and unmarked closeness, in one levelled floor half brown, half blue under the enormous dome of the sky. . . . Two small clumps of trees, one on each side of the only fault in the impeccable joint, marked the mouth of the river Menam we had just left on the first preparatory stage of our homeward journey; and, far back on the inland level, a larger and loftier mass, the grove surrounding the great Paknam pagoda, was the only thing on which the eye could rest from the vain task of exploring the monotonous sweep of the horizon. Here and there gleams as of a few scattered pieces of silver marked the windings of the great river; and on the nearest of them, just within the bar, the tug steaming right into the land became lost to my sight.[12]

One morning early, we crossed the bar, and while the sun was rising splendidly over the flat spaces of the land we steamed up the innumerable bends, passed under the shadow of the

[7] London: Adam and Charles Black, 1910, pp. 10–14.

[8] "Falk," Selected Stories of Joseph Conrad, p. 189, New York: Doubleday, Doran, 1930.

[9] *Ibid.*, pp. 164–165.

[10] *Ibid.*, p. 209.

[11] *Ibid.*, pp. 165–166.

[12] "The Secret Sharer," "Twixt Land and Sea," p. 91.

great gilt pagoda, and reached the outskirts of the town.[13]

About mid-day we anchored a mile outside the bar. . . . While watching the work from the poop. . . . I detected in it some of the languor of the six weeks spent in the steaming heat of the river.[14]

I believe he had partly fretted himself into that illness; the climate did the rest with the swiftness of an invisible monster ambushed in the air, in the water, in the mud of the river bank.[15]

Thus in his portrayal of the Menam River, of Pahnam Pagoda and of the scene at the mouth of the river, Conrad presented an authentic picture.

It is a fascinating game to compare Conrad's geography throughout in the same way with whatever can be found in reliable geographies and travel books. With vivid truthfulness "The Shadow Line," "Falk" and "The Secret Sharer" present Bangkok and the lonely areas of the east Siamese gulf. The setting of "Freya of the Seven Isles" lies in a thick group of tiny islets directly south of the Malay Peninsula and within sight of the low swampy coast line of east Sumatra. They are forest-covered hills, well drained and healthful and, so, very different from the pestilential coast toward the west. Nelson's island of the story is true to the actual geographical character of that section.

Conrad visited Singapore a number of times. He took a home-going boat from the city in 1881, after he had escaped from the burning *Palestine,* which sank west of Java. He was there again in 1885, and in 1887 he was in the Singapore hospital for three weeks, recovering from an injury received while he was on the *Highland Forest.* During the period while he was making the important Bornean trips as mate on the *Vidar,* he was in Singapore, the starting point of the route, five or six times. "The End of the Tether" contains an example of Conrad's passion for accuracy. A comparison of the Singapore of the story with a chart of Singapore included in "Federated Malay Railways," an official booklet of 1914, shows that he placed the Esplanade, St. Andrew's Cathedral, the Government House, the library, the harbor obelisk, etc., with great exactness. He even stated that it was three miles by tramway from the library to the New Harbour Docks (The name had been changed to Keppel Harbour by 1914, as the booklet explains), and the scale provided for measuring distances on the map justifies that statement.

Home-going voyages took him through the Straits of Malacca. The geographical variety to be found along its shores is compressed with great precision, judging from authoritative descriptions, into the background of "The End of the Tether." Captain Whalley's points of trade are on the charts—Low Cape, Batu Beru and Melantan on the Sumatran coast, and Malacca, Pangu and Tenasserim on the mainland. There is extreme contrast between the low-lying Sumatran shore on the west and the rocky islands to the north. To quote from the story:

From Low Cape to Malantan the distance was fifty miles, six hours' steaming for the old ship with the tide, or seven against. Then you steered straight for the land, and by and by three palms would appear on the sky, tall and slim, and with their dishevelled heads in a bunch, as if in confidential criticism of the dark mangroves. The *Sofala* would be headed towards the sombre strip of the coast, which at a given moment, as the ship closed with it obliquely, would show several clean shining fractures—the brimful estuary of a river. Then on through a brown liquid, three parts water and one part black earth, on and on between low shores, three parts black earth and one part brackish water, the *Sofala* would plough her way upstream.[16]

So is the Sumatran coast, a very different place from the section of clear

[13] "The Shadow Line," p. 47.
[14] *Ibid.*, p. 73.
[15] *Ibid.*, p. 67.
[16] "Selected Stories of Joseph Conrad," p. 165.

waters and rocky reefs not many miles north, which, according to Reclus, are inhabited by "rude fishing communities of the Silongs who encamp during the south-west monsoon on the Mergui Islands, and at other times reside chiefly in their boats or on the beach."[17] Conrad wrote of it:

> They had just left a place of call on the mainland called Pangu; they were steaming straight out of the bay. . . . Across the wide opening the nearest of a group of small islands stood enveloped in the hazy yellow light of a breezy sunrise; still farther out the hummocky tops of other islets peeped out motionless above the water of the channels between, scoured tumultuously by the breeze. The usual track of the *Sofala* both going and returning on every trip led her for a few miles along this reef-infested region. She followed a broad lane of water, dropping astern, one after another, these crumbs of the earth's crust resembling a squadron of dismasted hulks run in disorder upon a foul ground of rocks and shoals. Some of these fragments of land appeared, indeed, no bigger than a stranded ship; others, quite flat, lay awash like anchored rafts, like ponderous, black rafts of stone; several, heavily timbered and round at the base, emerged in squat domes of deep green foliage that shuddered darkly all over to the flying touch of cloud shadows driven by the sudden gusts of the squally season. . . . The multitudes of seafowl urging their way from all the points of the horizon to sleep on the outer rocks of the group, unrolled the converging evolutions of their flight in long, sombre streamers upon the glow of the sky. The palpitating cloud of their wings soared and stopped over the pinnacles of the rocks, over the rocks slender like spires, squat like ruins, over the lines of bald shoulders showing like a wall of stones, battered to pieces and scorched by lightening—with the sleepy, clear glimmer of water in every breach. The noise of their continuous screaming filled the air. . . . But when the *Sofala* happened to close with the land after sunset she would find everything very still there under the mantle of the night. . . . Sometimes there were human eyes open to watch them come nearer, travelling smoothly in the sombre void; the eyes of a naked fisherman in his canoe floating over a reef. . . . A few miserable, half-naked families, a sort of outcast tribe of long-haired, lean, and wild-eyed people, strove for their living in this lonely wilderness of islets, lying like an abandoned outwork of the land at the gates of the bay. Within the knots and loops of the rocks the water rested more transparent than crystal under their crooked and leaky canoes, scooped out of the trunk of a tree.[18]

[17] "Asia," p. 491.

Conrad acquired his most important experience in the East on the *Vidar* in 1887 and 1888. Each trip required three weeks, and he made five or six in all. The *Vidar* rounded the west, south and east coasts of Borneo and touched ports in west Celebes. Out of these trips grew the background scenes for the three novels concerning Tom Lingard and for several short stories. From these great books Borneo emerges so real that one can not read and escape the sensation of having seen that enormous, thick, dark, continent-like island with its smooth, dangerous coast line and its mangrove and atap-palm-lined muddy rivers, nor without knowing the intense heat and fearful beauty of its hot jungles and swamps. The descriptive books bear out every detail which Conrad attributes to Borneo, but none of them leaves his overwhelming impression of actuality. Thus, for an example in detail, German writes in his "Handbook of British Malaya" that there the frequency of thunderstorms is probably the highest in the world, but it takes Conrad's pages to impress us with the quality of such thunderstorms.

> A light frown ran over the river, the clouds stirred slowly, changing their aspect but not their place, as if they had turned ponderously over; and when the sudden movement had died out in a quickened tremor of the slenderest twigs, there was a short period of formidable immobility above and below, during which the voice of thunder was heard, speaking in a sustained, emphatic and vibrating roll, with violent louder bursts of crashing sound, like a wrathful and threatening discourse of an angry god. For a moment it died out, and then another gust of wind passed, driving before it a white mist which filled the space with a cloud of water-dust that hid suddenly from Willems the canoe, the forests, the river itself. . . . He made a few hurried steps up the courtyard and was arrested by an immense sheet of water that fell all at

[18] "The End of the Tether," "Selected Stories of Joseph Conrad," pp. 241–244.

> once on him, fell sudden and overwhelming from the clouds, cutting his respiration, streaming over his head, clinging to him, running down his body, off his arms, off his legs. He stood gasping while the water beat him in a vertical downpour, drove on him slanting in squalls, and he felt the drops striking him from above, from everywhere. . . . From under his feet a great vapour of broken water floated up, he felt the ground become soft—melt under him—and saw the water spring out from the dry earth to meet the water that fell from the sombre heaven.[19]

Conrad has left us our finest existing description of a tropical lagoon ("The Lagoon"). Whoever wishes to know the out-of-the-way Tiger Islands should read "Victory." "Karain," "The Rescue" and "Lord Jim" take us directly to south Celebes. The most far-flung situations in the fiction are two islands: mountainous Mauritius near Madagascar of "A Smile of Fortune," and Malata of "The Planter of Malata," as far east as to feel the refreshing Pacific breezes. Nowhere in all that area was a flagrant geographical error made.

To be sure, Conrad sometimes used his artist's right to build his own scene, but he constructed only of native materials gathered together and redistributed with wholly natural effect. Thus, as far as we know, he never visited the west coast of Sumatra, an important scene in "Lord Jim." He placed Patusan very exactly up a river Patusan, which entered the ocean one hundred miles south of a headland so described that it must have been Atjeh. At that place there is no Patusan but, instead, the Tenom River, which Conrad's descriptions fit perfectly. A long search places the name "Patusan" in Borneo up the Batang Lupar River. This Patusan was famous in the days of the first Rajah Brooke as a pirate resort, where two Arab brothers occupied a hill fortress like the one held by the pirate Arabs of the Patusan of "Lord Jim." Sir James Brooke's diaries were a quarry from which Conrad mined bits of plot, character and situation for his novels. Patusan is true to the Sumatran scene, but the ghost of Borneo haunts it.

Alfred Wallace's "The Malay Archipelago" even more than Brooke's diaries influenced Conrad's fiction. Wallace was so trustworthy a source that Conrad never hesitated to consult him when he left the territories of his own experience. The Bali of "Almayer's Folly," the Timor of "Victory" and the east Celebes of various stories come from "The Malay Archipelago," but they are accurate because Wallace was accurate. Never would Stein of "Lord Jim" have told his wonderful story of capturing a Celebes butterfly if Wallace had not actually caught the original of that same gorgeous creature years before.

A century ago, Malaysia was nearly as inaccessible as the moon to the majority of Westerners, but the last fifty years have added much to our knowledge of it. New books appear annually about it, and parts of it have become well-advertised tourist resorts. General interest in the archipelago grows. It is not probable, however, that another writer of the caliber of Joseph Conrad soon will record its fascinating contours for us. His Eastern fiction will remain one of the permanent literary contributions about that particular section of the globe.

[19] "An Outcast of the Islands," pp. 282–283.

SCANDINAVIA'S FUEL PROBLEM

By Dr. W. H. VOSKUIL

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THE Scandinavian economy is founded essentially upon the production for the world market of commodities of high exchange value and of relatively small bulk. This is true, in a large measure, of both agricultural and industrial economics. In Denmark, the low-lying, highly cultivated plain produces mainly grain, potatoes and sugar beets. Dairying is extensive and, under peacetime conditions, butter, cheese, pork and pork products are exported, as well as manufactured products of wood, metals and textiles. The food supply is augmented by large coastal fisheries.

In Norway, the preponderance of forested areas supports extensive lumbering, pulp and paper industries. Hydroelectric power supports electrochemical and electrometallurgical industries having as their products fixed nitrogen for agriculture, steel alloying materials (ferrochrome, ferro-manganese, ferro-silicon) for Europe's iron and steel centers, and aluminum. Sea fisheries (cod, herring, mackerel) and whaling supplement, in part, the meager agricultural resources of a land in which less than 3 per cent. is arable.

The Swedish economy is both larger and more diversified than that of either Norway or Denmark. The agricultural area is more extensive, forest resources are abundant, minerals exist in greater abundance and variety. The latter include copper, zinc, nickel, silver and coal, but most important is the Swedish iron, for centuries famous for its quality.

The forest products supply materials for extensive industries such as lumber, wood pulp and paper. Metal manufacturing is of a type rated for high quality and specialty production based upon the excellent iron ores and electrometallurgical products and an abundance of low-cost water power. Sweden has the largest known reserves of high-grade magnetite in the world. Upon this resource is built an industry of small tonnage and high quality, the products of which are widely in demand. Sweden is also an important producer of ferro-alloys, particularly ferro-silicon, silica-manganese, silica-spiegel and ferro-chrome. Cheap electrical power accounts for Sweden's position as a producer of ferro-alloys, since the industry is dependent upon imports of manganese, tungsten, chrome and vanadium.

With one exception, namely, fuels, the Scandinavian countries and Finland have diversified mineral resources adequate to establish and maintain industrial operations to a greater extent than is true at the present time. Despite an overabundance of high-grade iron ore, an exportable surplus of iron and copper pyrites and fairly adequate reserves of numerous other industrial minerals, this region is an excellent example of the adverse effect on industrial progress that is due to a lack of domestic reserves of high-grade coal and crude petroleum.

In spite of extensive water-power developments and also the use of wood as fuel, the Scandinavian nations imported each year approximately 16 million to 18 million tons of coal and coke and 20 million barrels of gasoline, kerosene, fuel oil and lubricants. In their foreign trade relations, these three countries have intimate ties with both Great Britain and Germany. For decades they have depended almost entirely upon Great Britain for a coal supply, and only in recent years have Poland and Germany

encroached upon this market. For the products of her farms, forests and metal works, competition among European consumers is keener than at any previous time in history. The United Kingdom has long been a profitable outlet for Danish butter, bacon, eggs and lard. Among the minerals, Germany is in most instances the principal buyer, especially of copper and its ores, feldspar, granite, iron ore and pyrites. The Scandinavian nations thus have found themselves bound by trade relations to both the allied powers and Germany, profiting most by freedom of trade among its European neighbors.

The commanding position of the British coal industry in the Scandinavian market was a natural consequence of tidewater location of collieries, supplying the overseas market, lower transportation costs and a well-organized coal export industry. That their market should yield to competition from the Polish East Upper Silesian mines is the result of a combination of circumstances arising out of the post-war consequences of the treaty of Versailles.

Before the war both East and West Upper Silesia were Germany territory, and these fields together supplied the bulk of the coal needs in the eastern districts of Germany with some export to Russian Poland. In the post-war readjustments, the East Upper Silesian field was awarded to Poland, with its annual output of 30 million tons or over. This transfer, in 1922, of this field to Poland left eastern Germany without adequate local coal supplies, whereas Poland controlled a productive capacity in excess of its own needs. Under an agreement of three years' duration and terminating in June, 1925, Germany agreed to take coal from Poland at a rate of 6 million tons a year. Shipments during 1923 and 1924, however, exceeded this amount, the actual quantities delivered being 8.4 million and 7.0 million, respectively. In the meantime, Germany increased its productive capacity in the West Upper Silesian field to compensate its losses in the eastern field. At the expiration of the agreement in June, 1925, production in Germany's own field had so expanded as to take care of the local domestic needs and the imports from Poland practically ceased. The net effect of this development was to expand the productive capacity of the entire Silesian area. With surplus mine capacity available, the Polish producers were compelled to seek outlets elsewhere. The prolonged strike of the British miners in 1926 opened the way for entry into the Scandinavian market. Exports to these countries increased from 0.5 million tons in 1925 to 5.4 million tons in 1928, and remained above 5.0 million tons through 1930.

By agreement between the United Kingdom and Sweden in 1933, 47 per cent. of the coal annually imported by Sweden is furnished by the United Kingdom. A similar agreement with Norway assured for the United Kingdom 70 per cent. of Norwegian imports.

German exports of coal to the Scandinavian countries, while considerably below the level of British and Polish coal shipments, nevertheless showed substantial gains in recent years. The principal form of fuel supplied by Germany was coke.

The profitable economic relationships of Scandinavia with its western European neighbors was rudely upset by the outbreak of hostilities among the major powers. The conquest of Poland interrupted this major source of coal supply and British shipments were hampered by the blockade of the Kattegat. Sweden, by reason of its land-locked position, was especially affected. The index of coal prices in Sweden (1913 = 100) rose from 128 in January, 1939 to 134 in August, 191 in September, 202 in October, 208 in November and 239 in

December, as against 125 in December, 1938.

The invasion of Norway, in April, 1940, extended and intensified an already critical condition with respect to fuel supplies. Occupation of Danish and Norwegian ports by the Germans severed the last connection of the Scandinavian nations with their customary sources of coal supply and left open to them only so much as the Germans are able and willing to supply, supplemented by meager shipments from the United States.[1]

Denmark, normally importing about 6 million tons of coal and coke, of which Germany supplied about 1 million, is turning in its predicament to peat moss as a supplementary fuel. Germany, with commitments of 12 million tons annually to Italy, may not be in a position to deliver coal to Denmark. As a result of coal and coke shortage, purchases are limited to one week's supply for individuals and two weeks' supply for industries.

Nor is the situation with regard to petroleum products a happy one. The Norwegian tanker fleet, the third largest in the world, is in the possession of the allied powers. Neutral tankers will hardly venture toward Norwegian ports against the British blockade. The conquerors have no oil to spare for civil uses in the Scandinavian nations when their own war needs are limited. The prospect of a fuel famine with its dire consequences rises like a specter on the horizon.

The situation in Norway is particularly critical. Although Norway uses a smaller quantity of liquid fuels than either Sweden or Denmark, she depends upon motor fuels and gas oils to operate her vast fishing and shipping fleets, so vital to the Norwegian food supply.

[1] Coal shipments from the United States to Scandinavian nations in 1940 were as follows: January, 19,611 long tons; February, 83,478 long tons; March, 80,406 long tons.

The fate of stocks of refined oil products in Norway at the time of the German invasion is not known. If these were sequestered by the German forces for military use, then it appears unavoidable that severe suffering and food shortages will occur next winter.

The Swedish position appears to be more fortunate than Norway and Denmark only in one respect. The nation is now virtually in German hands and Germany could enforce whatever demands she might choose to make without firing a shot or landing a company of soldiers. The nation therefore is spared the rigors of an invasion and occupation by armed forces. Sweden can not operate her industries for two weeks without the help of German coal. Germany is therefore in a position to compel the Swedes to safeguard the iron ores vital to German needs, and, if need be, improve the dock facilities at Lulea and increase the capacity of the iron ore railroad. In fact, if the Germans wish to use the port of Narvik by way of Sweden and the Gulf of Bothnia, it is doubtful if the Swedes can do anything but cooperate.

The immediate problem of Scandinavia, during the period of hostilities, is to re-orient their industrial and commercial activities to a condition which has cut them off from the world beyond the Baltic. How formidable is this task becomes evident from an examination of these nations' principal items of import. Raw materials vital to agricultural and manufacturing industries were, in normal times, obtained mainly over Atlantic sea lanes. For Denmark, the fertilizer materials essential for the maintenance of soil fertility overshadowed all other mineral imports. Phosphate from Morocco is probably unavailable, while Chilean nitrate imports are subject to the approval of the British government. Potash is still available from Germany, provided she can provide the transportation facilities.

For Norway and Sweden the problem is even more critical. In addition to the imports of foodstuffs and the contribution of ocean fisheries, these nations imported significant tonnages of two groups of minerals, the fertilizer group and industrial ores. The former are derived from the same sources and present much the same problem as that confronting Denmark in her efforts to maintain soil productivity and a food supply. The industrial ores and minerals furnish the raw materials for the manufacture of specialized and high quality materials with which Norway and Sweden, particularly the latter, supplied the industrial nations of western Europe. Among these are chromite, manganese ore, alumina and bauxite, china clays, refracting materials, gypsum, rough copper, sulfur and salt. A trade treaty for the exchange of goods between Sweden and Russia will scarcely compensate for the loss of Sweden's trade with the West. For various reasons—a lack of the raw materials needed in Swedish factories or inadequate transportation facilities or long overland distances for the transportation of industrial ores—the USSR will be unable to supply the materials of which Sweden is now deprived. Moreover, she remains utterly dependent upon Germany for coal and coke, for it is hardly conceivable that Russian coal, even if it could be spared for export, could be shipped by land and water from the Moscow Basin or the Donetz Basin in sufficient quantities to maintain Swedish industrial activity.

The immediate outlook is one of industrial depression, increasing unemployment and shortages of materials of foodstuffs becoming more acute with time. With regard to the more distant future, it appears that only a decisive victory for the western powers can save the Scandinavian countries from becoming dependencies of the German Reich.

TREND OF RACES IN CANADA

THE British races, which represented 51.9 per cent. of the Canadian population in 1931, accounted for only 40.6 per cent. of the births; the French with 28.2 per cent. of the total population contributed 38.9 per cent. The Anglo-Saxon births were thus some 22 per cent. fewer than expectation on the basis of their numerical importance in the population as a whole and the French exceeded expectation by 38 per cent. on the same basis. Save for the Asiatics, who are numerically the smallest in the table, births for the other groups varied much less from expectation than did those of the dominant Canadian stocks, despite their having distinctly unfavorable sex distribution. That, of course, does not apply to the North American Indians.

These figures reveal much as to the prospective racial composition of the population. If the differential fertilities of the principal origins in Canada continue at anything like the present levels, British races before long will constitute a rapidly decreasing minority and other races a rapidly increasing majority of the Canadian population. Disproportionately heavy immigration of Anglo-Saxons from abroad would, of course, retard the decline in the relative importance of that origin, while disproportionately heavy emigration (which takes place at the ages of highest fertility) would hasten it. Non-Anglo-Saxon races are already contributing almost 60 per cent. of the gross additions to the Canadian population, by birth. They are contributing an even larger proportion (70–75 per cent.) of the *net natural increase* because their age distribution, for the time being at least, is peculiarly favorable to low mortality. Change in ethnic structure is, of course, cumulative and the rapidity with which two series of population growth diverge increases with the passage of time in the absence of offsetting influences such as immigration or changes in differential birth and mortality rates. On the present basis of natural increase, it will be only a few decades until the French are numerically the largest race in Canada and a few generations until foreign European races will outnumber the Anglo-Saxons.—*W. L. Hutton, in The Eugenics Review (London).*

BOOKS ON SCIENCE FOR LAYMEN

FACT OR FALLACY[1]

ARE telepathy and clairvoyance actually within the range of powers of some individuals or are they imaginings of superstitious and credulous minds? This book presents the evidence obtained from experiments during the past sixty years for the purpose of obtaining a scientific answer to these alternative questions.

Telepathy—the influencing of one mind by another at a distance without the mediation of any of the senses—is found, upon analysis, to be at the basis of belief in magic, and it enters largely into theology. Belief in telepathy having thus come down in the traditions and folklore of all peoples and having acquired sanctity in their religions, it is naturally very widely accepted, at least in some vague form.

Clairvoyance—foreseeing the future—is implicitly assumed in all beliefs in oracles and prophets, and consequently permeates nearly every theoolgy. Our minds have been so thoroughly conditioned to the acceptance of telepathy and clairvoyance that we ought not to be surprised that a magician will draw a larger audience even in a college than a lecturer on literature, science or philosophy. Primitive mass beliefs often completely blanket the most brilliant achievements of the human mind.

Yet many scientists reject both telepathy and clairvoyance as impossible. They recall that the cruder forms have gradually disappeared as knowledge and critical attitudes have increased. They note that the most confident followers of these theories are usually ignorant, credulous and lacking in intellectual integrity. Moreover, these scientists are unable to conceive of any mechanism or means by which one mind independently of the senses can be in contact with another or can foresee what is beyond the curtain that shuts us off from the future. A few of them, however, make the rejoinder that many times in the history of science apparently absurd beliefs of primitive peoples have contained elements of important truths. Beliefs so widely held, whether or not they are of any value except for the comfort they give those who entertain them, are evidently worthy of examination with scientific thoroughness. This is what has been attempted repeatedly during the past sixty years, and in recent years most energetically and persistently by Dr. Rhine and his associates. These many investigations have been reported in this book. There can be no doubt that many of them and probably all of them have been undertaken with full honesty of purpose, and there can be no doubt that the authors of the present report make every effort to be scientifically objective and impartial. The conclusion reached is that there is evidence for extra-sensory perception (abbreviated to ESP), but evidently this bare statement should not be accepted by the reader without considering the nature of the experimental data and the methods by which it was obtained, for they are by no means so direct and simple as he might readily assume.

The conclusion that ESP is to some extent a reality depends upon statistical discussions which contain many pitfalls, though competent authorities have vouched for the correctness of those which the authors have used. Even so, the conclusions are not so convincing to the ordinary mind as they would be if they had been derived by some simple, direct test. But no simple, direct test has been found that answers the question as to the reality of ESP.

[1] *Extra-Sensory Perception after Sixty Years.* By J. G. Pratt, J. B. Rhine, Burke M. Smith and Charles E. Stuart. xiv + 463 pp. and 361 references to literature. $2.75. 1940. Henry Holt.

It is impossible within reasonable limits of space to describe intelligently the method of testing the reality of ESP, but the spirit of the method can be simply illustrated. Suppose the numbers 1 to 6 are painted on the six faces of a perfect cube. To test whether a person A has the power of *telepathy*, suppose another person B takes the cube into a closed room, shakes it in a box and throws it at random on a horizontal plane. After B notes the number that is on the top face of the cube and thinks of it intently, the "subject" A in another room attempts to state what it is. If he has no power of telepathy, he has one chance in six of guessing the correct number, and on the average of many trials will guess the correct number almost exactly one sixth of the time. This conclusion has been verified by many experiments. On the other hand, if he has perfect power of telepathy, he will call the correct number every time. Such a subject has never been found. But in many cases subjects have called the number (at least the corresponding thing in the real experiments) appreciably more than one sixth of the time. Such persons are concluded to have some power of telepathy. If a subject calls the correct number on the average one third of the time, it is concluded that he has good powers of telepathy, for, as can be determined by calculation, the probability of such a score in a long series is very small. In some experiments subjects have made scores against which the probability on the basis of pure chance is more than a million to one.

To test whether a person has *clairvoyant* ability, the subject might be required to guess what face of the cube will be up in advance of its being thrown. Surely the ability to foretell such an event is any amount simpler than to predict the details of an accident that occurs later in a distant place.

There are many questions concerning these experiments that will promptly arise in any inquisitive mind, most of which have been asked by investigators in this field. For example, are the so-called "psychics," who will use their powers for pay, good subjects? Are superstitious old women who believe they have exceptional powers good subjects? If a person is a subject at one time is he (or she) always a subject? Has he (or she) the power regardless of who the other participant in the experiment may be? What are the effects of stimulating and depressive drugs? Of fatigue or the hypnotic state? Of the distance between the subject and the other person? Of their personal relations? And so on in almost an endless list. Answers to many such questions are given in the book.

What conclusion will a person get from reading the book? He will certainly be convinced that proof or disproof of ESP is a very difficult task and that a vast amount of sincere work has been done in attempting to establish one. If he is not a mathematician, the statistical discussions will probably not be very convincing and he will lay the book aside with his original opinion or prejudice essentially unchanged. But he will agree that it has been very much worth reading.

F. R. MOULTON

STRANGEST OF ALL POSSIBLE WORLDS[1]

THE wonderland which Dr. Gamow gives us in this delightful, thought-provoking book is far more wonderful than the setting for the remarkable adventures of Alice; for the latter world is one of pure imagination, while the former—apart from a really insignificant difference—is the one we actually live in. Curiously enough, the creator of Alice (like the Creator!) was a mathematician, but it remained for the relativity theorists to construct for us the wonderland

[1] *Mr Tompkins in Wonderland.* By George Gamow. x + 91 pp. $2.00. 1939. Cambridge University Press.

to end all wonderlands. It is to the credit of the author, whose technical contributions in the field are of first rank, that he is able to treat some of the astonishing consequences of the relativity formulation of the world in a not-too-serious vein.

The book concerns the amusing nightmares of Mr Tompkins, an ordinary mortal who after attending three popular lectures on relativity and quantum theory dreams that he inhabits several worlds where "phenomena usually inaccessible to our ordinary senses are so strongly exaggerated that they could be easily observed as the events of ordinary life." These worlds are governed by the same physical laws as our own, but with different numerical values for the physical constants, so that what appear to us to be slight (and usually negligible) "corrections" to the classical laws of physics are for Mr Tompkins very real and startling matters of daily experience.

Many of us, especially those not accustomed to the highly abstract way of thinking demanded by a formal study of the newer theoretical physics, will welcome Dr. Gamow's little book. Relativity and the Quantum Theory are subjects uncommonly difficult to interpret to the layman. Often such popularizations recourse to misleading analogies which confuse rather than clarify. The author's ingenious device of delineating the true story by changing the scale of the picture is what makes his book instructive as well as fascinating.

In the Appendix, the three lectures which induced Mr Tompkins's unusual visions are set down. They constitute as superb a piece of interpretive writing as anything that has appeared in this difficult territory of science.

The uniformly excellent and appropriate drawings illustrating the text are by John Hookham. Some readers may be puzzled by his avoidance of the conventional five-pointed star in several of the drawings.

Altogether, "Mr Tompkins in Wonderland" is entertaining, stimulating and instructive. The literature of popular science is richer for the existence of such a book.

IRA M. FREEMAN

BIRDS OF EASTERN NORTH AMERICA[1]

IN the years 1925 to 1929, the Commonwealth of Massachusetts issued a three-volume work on the birds of that state and of the rest of New England as well, from the pen of its late state ornithologist, Edward Howe Forbush. Both in text and in illustrations (by Fuertes and Brooks) it set a very high standard for regional works of its kind, and the demand for it soon exhausted the edition. Now, a decade after the publication of the third volume, it has been deemed wise to greatly condense the text as far as each species is concerned, but to add the hundred-odd birds found in North America east of the ninety-fifth meridian, but not recorded from New England, so as to make a single volume covering the eastern half of the continent. All the colored plates of the original work have been included and, in addition, four new ones by Roger Tory Peterson, depicting 27 of the notable southern species. Dr. May, who assisted Forbush in the earlier work, has prepared the abridged version. The result is a book of decided usefulness, illustrated in a manner that would otherwsie have been impossible in a work in its price class. Unfortunately, the plates have not been as carefully printed as in the original edition (the blue jay, pl. 58, for instance, is much too purplish; the horned larks, pl. 57, too reddish; the spoonbill, pl. 96, is not the right shade of pink, etc.).

The textual matter appears to have been condensed without any attempt to

[1] *Natural History of the Birds of Eastern and Central North America.* By Edward Howe Forbush. Revised and abridged by John Bichard May. Large 8vo. xxvi + 554 pp. 97 col. pls. $4.95. 1939. Houghton Mifflin Company.

bring it up to date. The items in the original version of the work that have been sacrificed for brevity have been the descriptions of plumages (which are largely taken care of by the plates), molts, measurements and local distribution and frequency of occurrence in New England. Furthermore, the paragraphs dealing with field identification marks, geographic range, nesting habits and season, have been reduced to concise, terse, almost telegraphic statements. The arrangement of the higher groups and their included species and also the scientific nomenclature used have been changed to conform to that of the fourth (last) edition of the American Ornithologists' Union "Check-List of North American Birds," which was published some time after the original version of Forbush's work.

A brief account of the background of the work and of the life of its original author forms an introductory chapter, while in the back of the book is given a nominal list of the birds of only accidental or casual status in eastern North America. There are two indices, one limited to scientific names and the other to the common names used in the book. There should be a wide usefulness for this volume.

HERBERT FRIEDMANN

AN OUNCE OF PREVENTION[1]

IT is an ancient adage that prevention is sixteen times more effective than cure. From the medical viewpoint such evaluation of the relative merits of prevention and cure is far too conservative. The importance of extremely early discovery of disease is well appreciated by Dr. Malford W. Thewlis in his new book.

The volume is hardly suited to nonmedical readers, but it should stimulate interest. The author has a thesis and apparently he made a superficial search of the literature for views which support it and largely ignored the rest. This thesis is that "Scientific individual prophylaxis is only possible when it is known what specific organic weakness is present." This is a fundamental truth, but unfortunately the suggestions as to how to ascertain such knowledge are weak. There is a lack of consideration of many clinical function test studies intended to reveal slight or moderate diminution of function reserve capacities. Symptoms of functional failure do not appear until functional capacity falls below functional requirements. Thus it happens that the huge reserves of the body may be silently depleted without symptoms which can but be revealed by test studies.

There can be no question of the value of any and all emphasis placed upon this viewpoint. Too long have practitioners of medicine been content to treat the sick and leave preventive medicine to "public health" methods of wholesale prophylaxis. The virtual conquest of typhoid fever, the control of malaria, the elimination of devastating epidemics of juvenile contagious diseases and many other impressive victories of preventive medicine are largely dependent upon impersonal and engineering measures. It is time preventive medicine became *individualized* and that the patient himself assume more of the responsibility for maintaining his own good health. And herein lies the most difficult problem of application of prophylaxis, which Dr. Thewlis hardly mentions. Personal preventive medicine involves effort and compliance with restrictions on the part of the patient. People rarely make personal effort to maintain health, though they will go great lengths in attempting to restore that which their own neglect helped lose. The emphasis of the importance of periodic health inventories is timely, but the book fails to point out sufficiently the pitfalls of such work in the infinite variability of individuals in their heredity, constitution, habits, personality and in their previous injury from the innumerable vicissitudes of existence.

EDWARD J. STIEGLITZ

[1] *Preclinical Medicine.* By Malford W. Thewlis, M.D. iii + 223 pp. $3.00. 1939. Williams and Wilkins Company.

NICHOLAS COPERNICUS

THE PROGRESS OF SCIENCE

THE QUADRICENTENNIAL OF THE "FIRST ACCOUNT" OF THE COPERNICAN THEORY[1]

COPERNICUS (1473–1543) was reluctant to publish his revolutionary theory that the earth moves, that it is a mere planet and all the planets revolve about the central sun. His "Commentariolus" in manuscript, describing the main points of his system, was circulated among sympathetic friends perhaps as early as 1512–15. His other minor work, "The Letter Against Werner," 1524, though polemic, avoided the heliocentric issue. His "absurd" ideas were ridiculed on the stage at Elbing in 1531. Papal secretary, Widmanstad, reported the new theories to Pope Clement VII in 1533, and Cardinal Schönberg in 1536 urged Copernicus to announce his system to the world.

When Rheticus, an unexpected visitor at Frauenburg in 1539, was welcomed by the aged astronomer, an intimate friendship began in spite of differences in age, country and creed. Rheticus, a German and a Lutheran, at 22 years of age in 1536 was a professor of mathematics at Wittenberg, storm-center of rising Protestantism. Copernicus, a Pole, approaching three score years and ten, was a Catholic canon, loyal to the church, bold in mind but anxious to avoid antagonism. He entrusted his manuscript of "De Revolutionibus" to his enthusiastic disciple and assisted him in mastering the contents. After "scarcely ten weeks" of study, Rheticus prepared and sent to his former teacher, John Schöner, of Nuremberg, his famous "Narratio Prima," which was published in 1540, just 400 years ago, *the first printed account of the Copernican theory.*

Although Rheticus intended to announce the heliocentric theory, first mention of it occurs about one third from the beginning. Before taking the final step, he evidently desired to impress his readers with the learning and achievements of his "Dominus Doctor," whose name does not appear. Copernicus was compared favorably with Ptolemy and Regiomontanus, the most distinguished astronomers of the second and the fifteenth centuries, respectively.

Rheticus passes the first and second books of the manuscript with brief comment. The first contains a general description of the heliocentric system and the second discusses apparent diurnal motion, which Rheticus says "does not differ from the common and received opinion."[2] The third book, given chief consideration, treats of the motion of the sun (?), the motions of the fixed stars (?) and the mutations of the equinoxes and solstices. Copernicus sets out not merely to "save the phenomena" but also to save the principle of uniform circular motions about their centers, which Ptolemy violated by the use of equants.[3] A large amount of data by the Greeks and later observers, including some by Copernicus, was used and the superiority of the results of the master was stressed. Precession of the equinoxes was considered variable, due to large observational errors, but its

[1] G. Joachimus Rheticus, *De Libris Revolutionum Narratio Prima*, Danzig, 1540. Georg Joachim von Lauchen, 1514–76, called Rheticus from Rhetica, the Latin name of the province of his birth. Quotations are from the translation by Edward Rosen, "Three Copernican Treatises," New York, 1939.

[2] An unequivocal statement of the truth, as Rheticus realized, would here divulge the fundamental difference between Copernicus and Ptolemy regarding the real diurnal rotation of the earth.

[3] The equant is an imaginary eccentric point from which the apparent motion seems to be uniform.

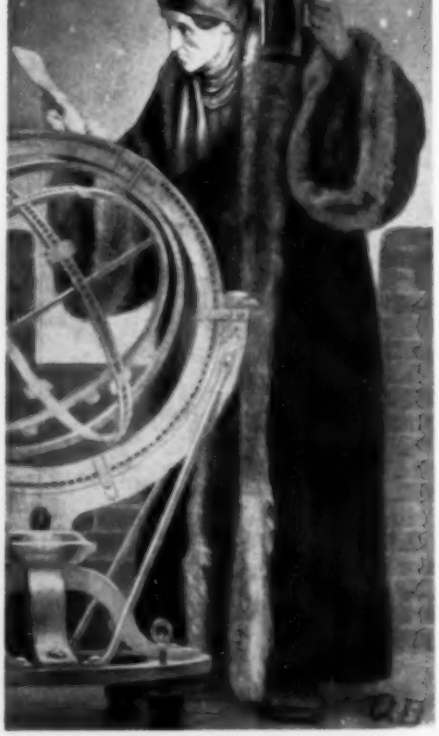
THE COPERNICAN SYSTEM

mean value was given quite accurately, about 50″ in an Egyptian year. Due to variable precession the length of the tropical year was considered variable and Rheticus himself attempted to harmonize discrepant results obtained at different periods. This was done to his complete satisfaction, "not without the greatest pleasure." The master advocated using the constant sidereal year and found its value to be about $365^{d}\ 6^{h}\ 9^{m}\ 36^{s}$.

The obliquity of the ecliptic was also considered variable. Available data showed a continual decrease from about 23° 51′ to 23° 28′, but Copernicus assumed it would be periodic and deduced 3434 years. Ptolemy was criticized for holding that the apogee of the sun was fixed and Rheticus advocated its twofold motion, "one mean and the other unequal." He also accepted the independent motions of the apsides of the other planets.

Here Rheticus abandons Copernicus and becomes astrological. "This small circle is in very truth the Wheel of Fortune, by whose turning the kingdoms of the world have their beginnings and vicissitudes." Also the end of the world will come when the eccentric reaches the value it had at the creation. The data call him back to the task of saving the phenomena, "marshalled on the battlefield of astronomy by the observations of 2,000 years, as by famous generals." But there is another delay in the announcement. The new lunar theory treated in book four is introduced, the equant is abolished and all the observations are satisfied. Similarly in the case of the planets with their motions, direct and retrograde.

Then comes the climax, the great announcement: "These phenomena, besides being ascribed to the planets, can be ex-



NICHOLAS COPERNICUS
FROM A PAINTING BY BRAUSEWETTER.

plained, as my teacher shows, by a regular motion of the spherical earth; that is, by having the sun occupy the center of the universe, while the earth revolves instead of the sun on the eccentric, which it has pleased him to name the great circle. Indeed, there is something divine in the circumstance that a sure understanding of celestial phenomena must depend on the regular and uniform motions of the terrestrial globe alone." But the courage of the author's convictions apparently falters as he adds later: "Which of these assumptions is preferable, I leave to be determined by geometers and philosophers (who are mathematically equipped)."[4]

The arrangement of the spheres is described with the sun at the center, "governor of nature, king of the entire universe, conspicuous by its divine splendor." (See accompanying diagram.) The diurnal rotation of the earth accounts for day and night and the apparent diurnal motion of the celestial sphere. The annual revolution of the earth explains the apparent annual motion of the sun and with the heliocentric orbits of the planets accounts for their apparent convolutions. The seasons are explained by a third motion, a conical turning of the earth's axis, considered necessary to keep its direction constant during the year, because the geometrical method employed made use of a moving radius vector rigidly attached to sun and earth. But its period was slightly less than a sidereal year and the small difference was correctly attributed to the mean precession, which constituted a fourth motion also variable. Here we have the first correct explanation of that phenomenon, a high tribute to the genius of Copernicus.

The great object was attained. All the celestial motions were explained by a simplified, harmonious system based on real motions of the earth around the sun, "which may be said to be the source of motion and of light." Some vestiges of the geocentric system remained, also the metaphysical assumptions and the limitations of the geometrical method. But little advance over the ideas set forth in this preliminary announcement by Rheticus was made by Copernicus in his "De Revolutionibus." On this foundation, moreover, Tycho Brahe, Galileo, Kepler and Newton added the superstructure, the analytical solution of the problem of motion of the heavenly bodies.

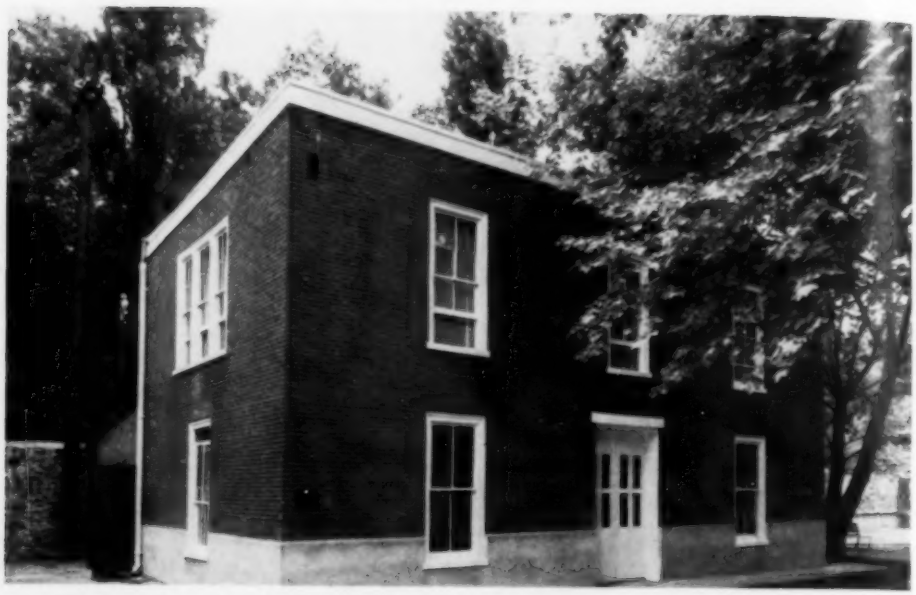
W. Carl Rufus

THE OSLER MEMORIAL BUILDING AT "OLD BLOCKLEY"

Behind the group of beautiful new buildings that compose the present great Philadelphia General Hospital—Old Blockley—there stands, a kind of relic of the past, a small, crude, two-storied, square brick building, very old and very shabby, known to every one of the present day as the "paint shop," but to those of older generations as the "morgue," the "mortuary," the "dead house" or the "green house," according to their particular vintages. For years it has been a place in which paints were stored, and bedsteads and other furniture painted. But it has peculiar interest attaching to it.

In the summer of 1884 Dr. William Osler, the new professor of clinical medicine in the medical department of the University of Pennsylvania, arrived in Philadelphia, to prepare for his winter's work. He at once saw that the number of beds assigned to him in the University Hospital was inadequate for the carrying out of the plans of bedside instruction that he contemplated, and turned his eyes toward the Old Blockley Hospital to whose medical board he was soon

[4] The assumptions, though figuratively expressed, refer to the sun at rest or in motion.



THE MEMORIAL BUILDING AT THE PHILADELPHIA GENERAL HOSPITAL

elected and where he remained one of the most active and useful members until he left Philadelphia to go to Johns Hopkins in 1889.

Fifty years ago few autopsies were made in any Philadelphia hospital, and there was no demand for the complicated examinations that now overwhelm the great modern hospital laboratories. The little old "dead house" was, therefore, adequate to the purpose for which it was intended. The post-mortem room was small, with a simple autopsy table in the center, lighted at night or on dull afternoons by a double gas jet overhead. In front of the largest window, there was a high desk, upon which lay an enormous tome in which the autopsy records were written, as and if time permitted, by a resident physician appointed to act as clerk. As autopsies came at unexpected times, and he had many other duties, it often happened that he could not be found, when no notes were kept.

The pathologist to the hospital at that time was Dr. Henry Formad, who was also the demonstrator of pathology in the medical department of the University of Pennsylvania and the coroner's physician. He was a very busy man, as may be imagined, and therefore inclined to hurry through such autopsies as he was called upon to make, and to dictate very short notes. He was, also, inclined to escape the post-mortem operations altogether, when possible, by deputizing their performance to any member of the medical staff, or even any resident physician who was anxious or willing to conduct them.

This state of affairs in the autopsy room was Osler's opportunity, and he proceeded to make the most of it, dividing his time in the institution between the wards, where he studied the patients while alive, and the "dead house," where he examined their bodies after death. In the former he was just one of the medical chiefs, but in the latter he was the master pathologist, the ardent morbid anatomist and the willing and able teacher. He, therefore, gathered all the

younger men about him, and gave them never-to-be-forgotten lessons. There are many who remember him chiefly as a pathologist, which is unfair, for he was a great clinician.

When he was at work upon an autopsy, time seemed to lose all other values for him, and he sometimes worked over one body for hours. Nor was that all, for when he was at last finished, he would sometimes mount the high stool and write voluminous notes in the record book with his own hand, not trusting to the clerk, who might be inclined to skimp, or slur over, or omit altogether what was dictated, believing that the omissions would never be discovered.

The idea of transforming this old building into a memorial to him who long years ago had frequented it, who had there done much of the work for which he was famous and whose memory hallowed it was the inspiration of Dr. David Riesman, the former professor of clinical medicine in the Medical Department of the University of Pennsylvania and the chairman of the Medical Board of the Philadelphia General Hospital.

The idea of dedicating such a dilapidated edifice as a memorial may have shocked some persons and made others smile. It may even have been because it would cost the city nothing that caused the City Council to act favorably upon the recommendation, which they immediately did, but without providing any funds for reconstruction or rehabilitation. Moreover, the hospital had no other place suitable for the paint shop. So nothing was changed, and no progress made for several years. In the meantime, Dr. Riesman did not despair, but kept on working to bring his vision to fruition. He was, therefore, able to

ARTIST'S CONCEPTION OF CONSULTATION WITH OSLER
A PAINTING BY MR. DEAN CORNWELL.

announce at a time when many had forgotten all about the matter, that the members of the drug firm of John Wyeth and Brother had agreed to take charge of the matter, and that they would not only rehabilitate the edifice, but that they would also employ Mr. Dean Cornwell, R.A., to paint a picture of "Osler at Old Blockley" with which to adorn it when finished.

This proposal found immediate favor, and the hospital a new paint shop. Work was therefore begun. Such attention as it now received had been unknown to the little building for at least three quarters of a century. It was reroofed, repointed, repainted and replastered. Old partitions were replaced, so that it was again the structure as Osler knew it. It was, indeed, so furbished up as to be almost unrecognizable to those most familiar with it, just as a man whom one is accustomed to see in dingy overalls, with dirty face and hands, may scarcely be recognized when dressed for church on a Sunday morning. It was the same building, however—not changed, but glorified.

The dedication of the memorial was held on the afternoon of June 8, 1940, the exercises having been arranged by a committee consisting of Dr. David Riesman, chairman, Dr. William E. Hughes, Dr. William G. Turnbull, Dr. William N. Bradley, Dr. Jefferson H. Clark, Dr. Marion Rea and Dr. Robert J. Hunter. Invitations were sent far and wide to the profession and laity and brought more than a thousand guests to crowd the Auditorium of the hospital, overflow into the hospital and spread through the grounds. There was, however, one sad note, for Dr. Riesman, by whom the whole had been planned and who was to have presided at the ceremony, had died but a short time before. Very appropriately, the first address, given by Dr. William Egbert Robinson, was a eulogy to him.

Dr. William E. Hughes made some introductory remarks, Dr. Joseph McFarland spoke of "Osler as I Knew Him," and Dr. W. B. McCallum, of the Johns Hopkins University, of "Osler at Blockley."

At the close of the program everybody walked out into the hospital grounds to visit the memorial building. Old Blockley had not seen such a brilliant company of well-dressed ladies and gentlemen for many a long year, if ever before. The little building was constantly filled with those anxious to recall earlier days, or to satisfy their curiosity, while long lines awaited their turn. Much interest centered about Cornwell's painting, which was a surprise and something of a disappointment.

As Osler left Blockley more than fifty years ago, the artist could only represent things as he imagined them with the aid of such suggestions as a few of the older men could give him. The result of this artist's license is certainly interesting, and possibly meritorious, but it is not historic, and there are still enough oldsters of the Oslerian period about to point that out. Perhaps no one can say that no such scene ever took place, but no one can remember ever having seen Osler sitting out of doors, surrounded by a large group of resident physicians, discussing an old female patient lying on a stretcher, while a well-dressed lady from outside listens to what he has to say. It is, perhaps, unfortunate that he has been so represented, for years hence, when all who lived at that time have passed away, the picture may be brought forward in evidence that such outdoor clinics were the custom between 1884 and 1889.

JOSEPH MCFARLAND

SIR ARTHUR HARDEN

EMERITUS PROFESSOR OF BIOCHEMISTRY AT LONDON UNIVERSITY, WHO DIED ON JUNE 17. HE SHARED THE NOBEL PRIZE IN CHEMISTRY FOR 1929 WITH PROFESSOR HANS VON EULER, AND WAS KNIGHTED IN 1936 BY KING EDWARD VIII.

THE SMITHSONIAN–FIRESTONE EXPEDITION TO LIBERIA[1]

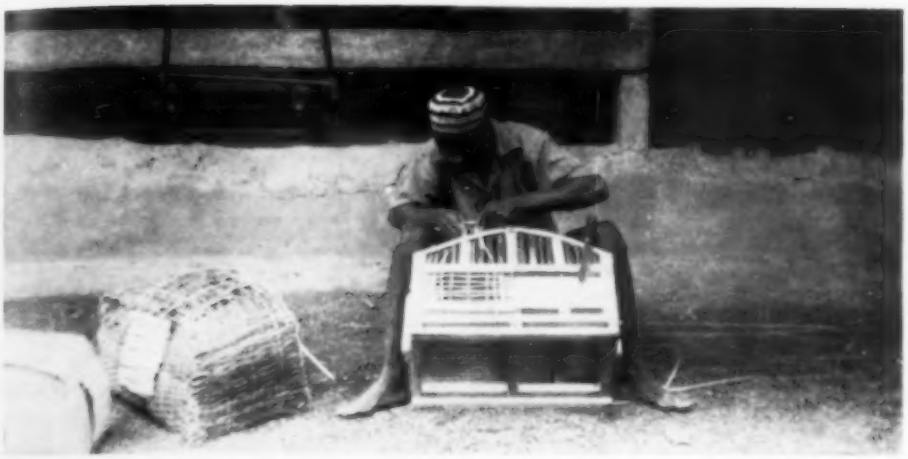
Two of us, accompanied by Ralph Norris and Roy Jennier of the National Zoological Park, sailed in February for Monrovia, via Dakar, Conakry and Freetown.

At Monrovia we were greeted by George Seybold, maanger of the rubber plantation, and taken to his home at Harbel, fifty miles inland. The plantation remained our headquarters during our stay of four and a half months in the country. In addition to comfortable living quarters we were supplied with a "rice shed" in which to keep animals. This was so enormous a warehouse that we despaired of ever securing enough animals to make a showing in it.

We spent a large portion of our time on five different trips into the interior, living in native villages and getting the bush natives to collect live animals. Our first journey was to Belleyella, a six-day walk inland, and our first experience with hammock travel. The caravan travels throughout the day, native boys not caring to rest at noon but preferring to reach their destination, where they eat their one meal of the day—usually rice and palm oil. During the hotter part of the day one rides in a hammock, which is fastened to a frame and carried on the heads of four boys. On approaching or passing through a village they sometimes break into a dance, accompanied by chants and the beating of drums by the extra carriers—quite a spectacle, but one which left us feeling at night as though we had ridden horseback a long day's journey over a hard road.

[1] The Firestone Tire and Rubber Company financed this expedition, which was for the purpose of collecting live animals for the National Zoological Park in Washington, D. C.

A DUG-OUT CANOE SERVES AS FERRY ACROSS THE ST. PAUL RIVER



NATIVE-MADE ANIMAL BASKETS

THESE SPECIALLY MADE BASKETS, WHICH WERE BALANCED ON THE PORTERS' HEADS, WERE CARRIED BACK TO BASE CAMP.

Because of food requirements for our caravan boys it was necessary always to camp in native villages, where comfortable mud huts were furnished us. We were surprised at the absence of annoying insects and other pests. There are mosquitoes that cause malaria but they bite very quietly; we never saw a bedbug or a flea, and very few cockroaches or other fauna which in most places in the tropics tend to do away with any life in a native village.

Our first acquisition was a young chimpanzee whose mother had been shot two days before near our trail. A potto discovered asleep on a branch overhanging the trail was shaken down and popped into a bag. A tiny squirrel-like dormouse brought to us tied to a short string adapted itself immediately to being a pocket pet. The only pet observed in native villages was an occasional mongoose-like animal. We bought a few of these, as well as several baby civet cats.

A number of young hornbills were secured by sending natives up to rob nests in hollow trees. Rhinoceros and Gaboon vipers were brought in to us commonly, as well as hinge-back tortoises and a broad-nosed crocodile. This last lives in small streams in the forest and is very seldom seen.

All our bush trips were similar. On one we camped for a week at the base of the sacred mountain in the Gibi country but were unable to secure permission to collect at any altitude there, as the natives consider the forest holy and have never allowed any outsider, white or black, to enter. We did collect on a similar mountain eight miles to the north from our camp, and obtained batrachians, fishes and insects at an altitude of about 400 feet above the base of the mountain (which was perhaps 2,000 feet high).

A side trip was made to the American Episcopal Mission at Bromley on the St. Paul River, where an employe of the Mission who was also a member of the secret Snake Society secured some specimens for us, and we fished a nearby stream, accompanied by Bishop Kroll and the staff of the school. An army of driver ants occupied the only accessible

PARAMOUNT CHIEF BOIMA QUAE
OF BENDAJA, CAPE MOUNT DISTRICT, LEADER OF THE GOLA TRIBE.

part of the stream's bank. After observing them for a while in the hope of finding Dorylophiles (beetle guests), we dispersed them by throwing buckets of water on the column, which after half-an-hour's flooding turned in another direction.

From Cape Mount near the Sierra Leone frontier we went into the Gola country at Bendaja, a two-days journey.

A BABY PIGMY HIPPOPOTAMUS
AT THE BASE CAMP AT HARBEL.

Traveling by launch, dug-out canoe, on foot and, when the path permitted, in rickshas devised by the missionaries there, and made of cane chairs mounted on bicycle tires—a convenient method of travel for an entomologist, who with a little practice can sit in the chair and net tiger beetles that fly by, as the two ricksha boys, one in front and one behind, trot along the road. Our camera boy, Pepe, would run alongside the ricksha and now and then stoop and grab a beetle, the forty-pound load on his head being of no inconvenience at all.

A KPELLE GIRL
THE HEAD-DRESS AND CICATRICES ON THE ABDOMEN SHOW THAT SHE HAS COMPLETED HER TWO YEARS' SECLUSION IN THE BUSH SCHOOL.

At Bendaja one of the local hunters was especially skilful at netting antelope, and we returned with two water chevrotains, which had to be carried in palm-wood baskets on the heads of porters on the return walk through the

A BABY CHIMPANZEE

SWINGING ON A YOUNG RUBBER TREE OUTSIDE THE BASE CAMP.

forest and along the beach to Cape Mount.

Our last inland walk was to a cocoa plantation that had been established by Polish immigrants, who had abandoned it to return to their own country at the outbreak of war.

While we were making these various bush trips, Mr. Norris and Mr. Jennier managed the rice shed, and natives brought in whatever they could find in the way of live animals. The collection grew slowly but steadily. One lot was sent home in May in charge of Mr. Jennier, and spent the summer at the Firestone exposition at the World's Fair in New York.

Toward the end of our time the propaganda we had made in the more distant villages produced results and four pigmy hippopotami were brought in. One of them had had its skull cracked and was dead before we saw it. Two of the others lived to reach the States and are thriving at the present time.

The collection which we brought home in August on the *S.S. West Irmo* of the Barber Steamship Line, after a 21-days run from Monrovia to Norfolk, included six duiker antelope of three species, four water chevrotains, a ratel and a water civet, crested eagles and other species new to the national collection. In addition some thousands of alcoholic and dried specimens were collected for the National Museum, where they are being assorted for study.

WILLIAM M. AND LUCILE Q. MANN

THE ECLIPSE EXPEDITION AT PATOS, BRAZIL

BECAUSE broken clouds partly veiled the sun at Patos, Brazil, during the period of totality of the solar eclipse of October 1, only a partial record of the eclipse could be made through the instruments set up there by the expedition

of the National Geographic Society and the National Bureau of Standards. A complete report of the work has not yet reached Washington, but brief cables indicate that despite the clouds photographs were obtained of the inner corona and of the flash spectrum—the spectrum of the outer portion of the sun's atmosphere (the chromosphere) which first flashes momentarily by its own light as the light from the body of the sun is eclipsed, and which flashes a second time as the bright atmosphere is uncovered on the other side by the moon's disk, at the end of totality.

The observers report that they also got good records of the four times of contact: the instant when the edge of the advancing moon first appeared to meet the edge of the sun, the instant when the sun became covered by the moon, the instant when the light from the sun reappeared and the instant when the moon moved out of apparent contact with the edge of the sun. A constant check on these contact times is important to astronomers for the calculation of future eclipses.

The expedition's program of tests with radio signals to determine the be-

National Geographic Society

THE INSTRUMENT SET UP FOR OBSERVING THE TOTAL ECLIPSE AT PATOS

IN THE IMMEDIATE FOREGROUND ARE THE TWO LARGE SPECTROGRAPHS WITH THEIR TUBES DIRECTED TO THE POINT IN THE SKY TO BE OCCUPIED BY THE SUN AT ECLIPSE TIME. A REFLECTION GRATING WAS PLACED AT THE BASE OF EACH TUBE SO AS TO PROJECT ONE HALF OF THE SPECTRUM WITH A SPREAD OF 40 INCHES ON PHOTOGRAPHIC FILM AT THE UPPER END (THE FRONT) OF THE RECTANGULAR BOX. THE THIRD TUBE TO THE LEFT IS THE BARREL OF A TELESCOPIC CAMERA. TWO SOMEWHAT SMALLER CORONA CAMERAS FARTHER TO THE LEFT ARE HIDDEN BY THE LARGER INSTRUMENTS. THE EQUIPMENT FOR INVESTIGATING THE BEHAVIOR OF RADIO SIGNALS DURING THE ECLIPSE IS NOT SHOWN IN THE PHOTOGRAPH. THE SMALL TENT SHELTERS THE CHRONOGRAPH AND THE PROGRAM CLOCK. PILED IN THE BACKGROUND ARE SACKS OF UNGINNED BRAZILIAN COTTON.

havior, during eclipses, of ionized layers in the upper atmosphere (the so-called "radio-reflecting layers") was carried out successfully. Fortunately such tests are entirely independent of cloud conditions; the floating masses of water globules do not impede the passage of the radio signals. The impulses were sent vertically upward from a sending station housed in an automobile trailer, and the reflected signals were recorded on receiving instruments in the same enclosure.

M. K.

DR. CHEVALIER JACKSON AND THE BRONCHOSCOPE

DR. CHEVALIER JACKSON
AUTOGRAPHING DRAWINGS FOR HIS PUPILS IN BRONCHO-ESOPHAGOLOGY AT TEMPLE HOSPITAL.

At the age of seventy-four, Dr. Chevalier Jackson recently received the Distinguished Service Medal of the American Medical Association. Although this is just one of numerous awards presented to Dr. Jackson for his remarkable work in bronchoscopy, it demonstrates the esteem by which he is held by his fellow delegates to the annual medical convention in New York.

Though always frail in health and suffering from several attacks of tuberculosis during his career, he has given all his strength and enthusiasm to the practice of bronchoscopy, to the establishment of clinics throughout the world and to the training of assistants to carry on this vital work.

With the bronchoscope, the unusual instrument which he perfected, he has performed amazing feats of skill in saving the lives of many people, especially children, who had swallowed such indigestible objects as nails, tacks and fruit stones. In approximately 98 per cent. of these cases where foreign bodies were removed, the patients not only recovered, but they were completely cured.

MEDICAL ASSOCIATION MEDAL
RECENTLY AWARDED DR. JACKSON.

Gladys Muller

MANIKIN AND THE BRONCHOSCOPE

THE ARTIFICIAL PATIENT UNDERGOES "BRONCHOSCOPIC TREATMENT" FOR THE REMOVAL OF A NAIL.

Quite naturally, then, it has been through these spectacular cases that the bronchoscope has received world-wide recognition, but it is interesting to note that its greatest value lies in the prevention and diagnosis of disease.

The bronchoscope is a thin-walled brass tube about 16 inches long, although smaller ones are used for children. Through this the forceps are passed. These are operated like a pair of scissors. More than a hundred different instruments have been designed for use with the bronchoscope. Among these are a device which closes safety pins before they are pulled up through the tube, a fine sharp knife which cuts off small abnormal growths, and narrow prongs which grasp the head of a nail or tack. None of these ingenious instruments have ever been patented because they were devised solely for the purpose of benefiting mankind.

Light for the operation is furnished by a tiny electric light bulb. Dry cells furnish the necessary current. Placed as it is, at the end of the bronchoscope, the tiny bulb enables the doctor to see the interior of the lungs and bronchi.

In recent years the bronchoscope has been used to tremendous advantage in the early recognition of cancer of the lungs, bronchial tuberculosis and other serious diseases.

There are many people who have heard of the wonders of the bronchoscope and go to one of the clinics hoping to watch a doctor at work, but unfortunately outsiders are not admitted because the strictest sanitary regulations are employed as in other serious operations. But those who are interested in watching how the bronchoscope is operated can see the realistic exhibit at the Franklin Institute in Philadelphia, designed by Dr. Jackson and his only son, Dr. Chevalier Lawrence Jackson.

It consists of a manikin lying flat on its back with the bronchoscope extending from the mouth in the exact position as used in the clinics. One can look through a hole in the glass case which surrounds the exhibit, down through the bronchoscope to the location where a nail is lodged. Pushing a button starts the operation of the exhibit. Air can be felt coming out of the tube which corresponds to a person's "breath," and a faint red glow can be seen which is caused by the tiny light shining on the mucous membrane of the bronchial tube.

Over the manikin is one of the green sheets always used by Dr. Jackson in his clinic. This color, which does not reflect any glare, is preferable over the customary white sheets. The operations are performed in a darkened room so the eye can see more clearly through the small tube in the bronchoscope.

The exhibit is a living memorial to the two doctors who designed it; the one who began as a pioneer in a new and unknown field and became one of the great benefactors in the medical profession, and the other who continues to uphold the high standards set by his father.

EMILY DUANE WALLACE